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UNITED STATES DEPARTMENT OF AGRICULTURE
BULLETIN No. 748
Office of the Secretary
Joint Contribution from the Office of Farm Management
E. H. THOMSON, Acting Chief
and
Bureau of Plant Industry
WM. A. TAYLOR, Chief

Washington, D. C. PROFESSIONAL PAPER January 28, 1919

FARM PRACTICE IN GROWING SUGAR BEETS IN MICHIGAN AND OHIO

By

R. S. WASHBURN, Scientific Assistant, L. A. MOORHOUSE, Agriculturist, and T. H. SUMMERS, Scientific Assistant, of the Office of Farm Management; and C. O. TOWNSEND, Pathologist in Charge, Sugar Plant Investigations, Bureau of Plant Industry

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This study was made in order to ascertain the field practices that are employed in the production of sugar beets under typical humid conditions and to determine the relationship of these operations to the cost of growing this crop.

The data presented are based upon 320 farm records obtained from operators in Michigan and Ohio. The farmers who reported on their methods of producing sugar beets lived in the vicinity of Caro, Alma, and Grand Rapids, Mich., and in northwestern Ohio (fig. 1). The records discussed outline the work and show the returns for these farms during the crop seasons 1914 and 1915. The labor rates that prevailed throughout this period were not nearly so high as those for 1916 and 1917, which were greatly advanced by war conditions.

Note.—This is the third of a series of bulletins published by the Department of Agriculture giving the results of an investigation relative to the practice and cost of growing sugar beets in four of the most important areas in the United States. One of these bulletins gave the results obtained from a study of this enterprise in Utah and Idaho. Another contained a review of records that were taken in three Colorado districts. A subsequent publication will discuss the practice and distribution of costs in connection with the production of beets in three California regions.

The hours of man labor and horse labor do not vary greatly from one period to another. Moreover, the quantity of seed planted per acre will not change perceptibly throughout a given period, and the applications of manure or fertilizer are not likely to increase or

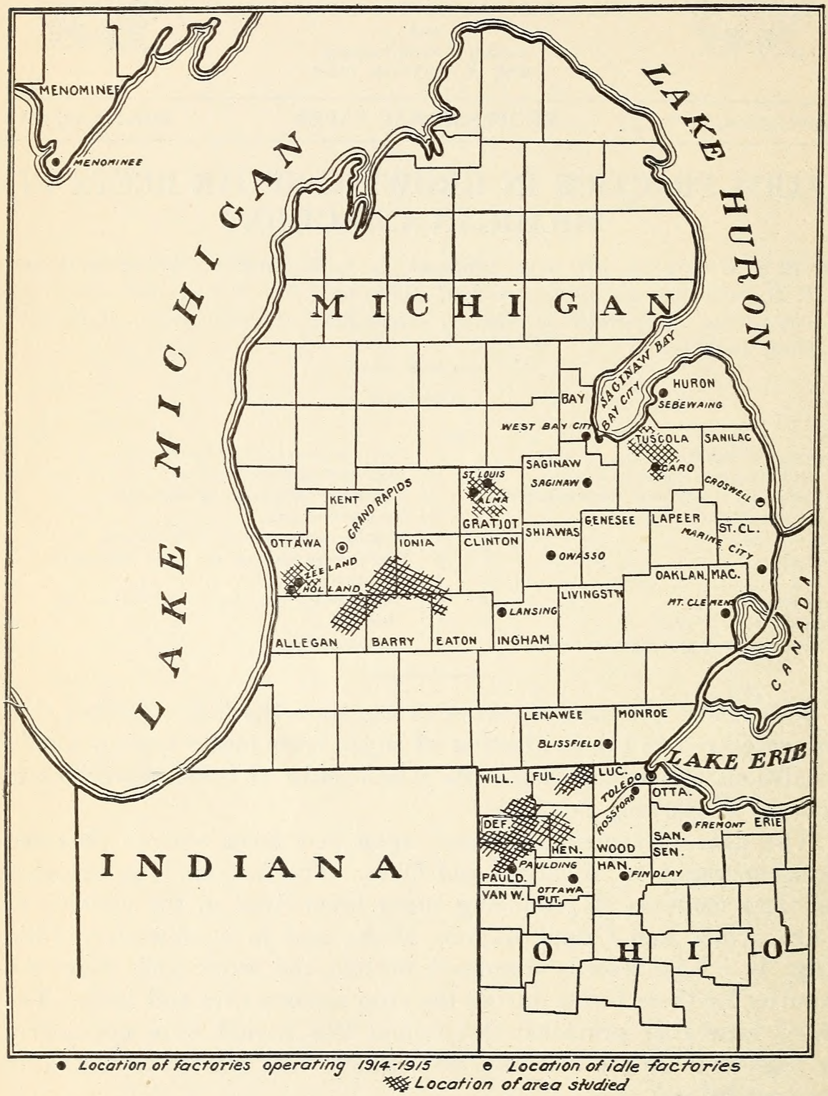

FIG. 1.—Map showing the districts in which records were obtained, also indicating the location of the beet-sugar factories in Michigan and Ohio.

decrease to any marked extent. Other necessary supplies will remain fairly constant. In presenting accompanying tables these facts have been kept in view, so that if the reader wishes to figure the cost of production on the basis of prices other than those prevailing when this study was made all that need be done is to apply any prevailing scale of prices to the more or less constant factors which have been determined in this study.[1]

SUMMARY OF RESULTS.

A fairly definite rotation system was found in each district visited. In the Caro, Alma, and Grand Rapids areas sugar beets followed corn or beans in the rotation, while in northwestern Ohio sugar beets or corn were planted on clover sod. On 39 per cent of the Ohio farms visited the sugar beet succeeded clover in the cropping system.

Manure was applied at an average rate of approximately 13 tons per acre on 201 out of a total of 320 farms.

Commercial fertilizers were applied on 68 per cent of the farms visited in the Caro district, 47 per cent at Alma, 78 per cent at Grand Rapids, and 39 per cent in northwestern Ohio. The rate of application ranged from 130 to 170 pounds per acre.

The dates of planting varied from April 5 to June 1. The seed was drilled in at a rate of 15 pounds per acre, and it cost 15 cents per pound.

The greater part of handwork on sugar beets was performed at a contract rate of $18 per acre for 22-inch rows, $16 for 24-inch rows, and $15 for 28-inch rows. Fifteen per cent of the farmers did their own blocking and thinning, 17 per cent hoed, and 10 per cent did their own topping. On the remaining farms this work was done on a contract basis.

Beets were hauled an average distance of 2.47 miles to loading station or sugar-factory dump.

Beet growers in the Caro district produced an average yield of 9.72 tons per acre, at a cost of $47.65, or $5.62 per ton; at Alma the average yield was 11.4 tons, and the cost amounted to $57.42 per acre, or $5.04 per ton. Grand Rapids growers reported an average yield of 10.16 tons, and the cost per acre averaged $53.05, or $5.21 per ton. Northwestern Ohio operators had an average yield of 13.17 tons per acre, costing $56.04, or $4.26 per ton.

Twenty-two men produced a yield of 8 tons or less per acre, at a cost of $49 per acre, or $7.05 per ton. Twenty-five men produced 14 tons and over per acre, at a cost of $58.18 per acre, or $3.92 per ton. Although the cost per acre increases as the yield increases the cost per ton decreases.

The labor cost was approximately 64 per cent of the total cost of producing sugar beets in the area visited. Materials, including manure, fertilizer, and seed, constituted about 11 per cent, and other costs, such as insurance and taxes, interest and rent, machinery use cost, and other miscellaneous expenses, amounted to about 25 per cent of the total cost of production.

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[1] Mr. James W. Jones, Agriculturist, Office of Sugar Plant Investigations, and Mr. M. R. Cooper, Scientific Assistant, Office of Farm Management, assisted in collecting the records discussed in this bulletin.

Approximately 96 per cent of the farmers in Michigan fed the beet tops to stock. In northwestern Ohio about half the producers fed and half plowed under the tops. Beet tops were valued at from $1.50 to $3.40 per acre.

METHOD OF TAKING RECORDS.

An investigation of this character involves an inquiry as to the man and horse labor required in the preparation of land for sugar beets as well as in regard to the subsequent care of the crop until the final product is delivered to the manufacturer. It also calls for definite information with reference to use of land, manure, fertilizer, and seed, and the apportionment or distribution of certain general costs to the various enterprises of the farm.

In order to secure the desired data on the practice and cost of growing sugar beets a suitable blank report form was printed; with this schedule in hand, trained enumerators visited the beet growers of the regions selected for these observations. Each operator consulted gave a complete description of the methods employed in growing sugar beets on his farm and furnished additional facts concerning the other important enterprises forming a part of his business. As far as possible, the acreage in beets and the yields obtained from each farm were checked with the sugar-factory reports. Inasmuch as some growers delivered sugar beets to more than one factory, it was not possible to make comparisons for all farms. (See Table I.)

TABLE I.—*A comparison of growers' estimates with factory records—Average acreage, yield, and return per acre, 1914–1915.*

District.	Number of farms.	Acres in beets per farm		Yield per acre.		Cash return per acre.	
		Estimated.	Factory.	Estimated.	Factory.	Estimated.	Factory.
				Tons.	*Tons.*		
Caro	73	14.33	14.22	8.82	7.56	$52.89	$46.32
Alma	49	9.57	9.36	11.65	10.43	69.91	61.90
Grand Rapids	36	6.40	6.32	10.16	9.67	61.32	58.45
Northwestern Ohio	57	15.19	14.63	13.15	12.68	72.74	69.39

In this investigation the Office of Farm Management had the cooperation of the Office of Sugar Plant Investigations of the Bureau of Plant Industry. The latter office was not only interested in the farm-management data that would be made available by this survey but was desirous of obtaining a detailed account of the field practice in typical regions. It was felt that these data would be exceedingly valuable in indicating some of the urgent needs of the farmer and would in turn assist in devising remedies or suggesting means of combating some of the enemies of this crop. Acknowledgement is due the farmers of these districts for their hearty cooperation. The questions that were asked were answered promptly and courteously, and the department is under obligation to them for this service.

DEVELOPMENT OF SUGAR-BEET INDUSTRY IN MICHIGAN AND OHIO.

The first four beet-sugar factories in Michigan were built during the year 1899 (fig. 2), and were located at Alma, Bay City, Caro, and Holland, respectively. Two additional factories were constructed in 1900. Other factories were built at the rate of three per year up to and including 1903. During the five-year period of 1899 to 1903 the beet-sugar industry became well established in this State. Sixteen factories are now available for the manufacture of beet sugar in Michigan; 15 of these were in operation during the period of this survey.

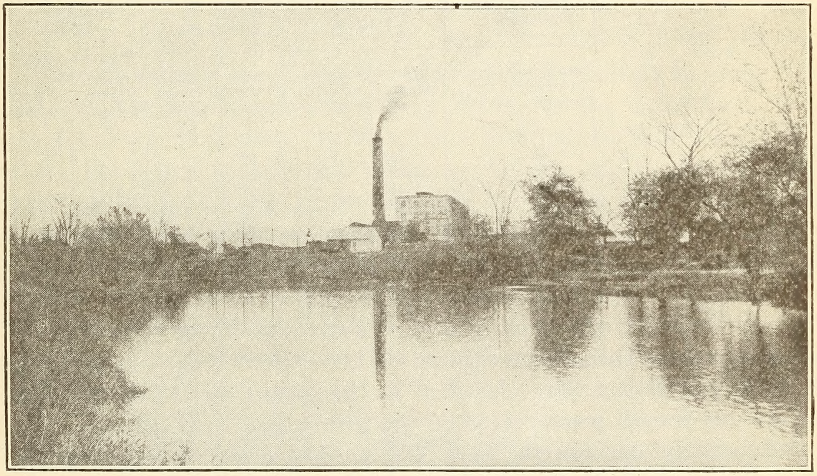

FIG. 2.—One of the first beet-sugar factories erected in Michigan.

In Ohio the first factory was built during the year 1900. No other factories were constructed until the period 1910–12, at which time four factories were erected and put in operation, making a total of five for this State; three of these contracted sugar beets and conducted active campaigns during the period of this survey. One factory was idle in 1914, but operated in 1915.

According to census figures for 1909, sugar beets were grown extensively in Tuscola, Bay, Huron, Gratiot, and Saginaw Counties, Mich. Paulding was the leading sugar-beet growing county in Ohio that year.

SIZE OF FARMS.

The size of the farm is one measure of the operator's business. It is of interest to know something about the common farm sizes in a region that has developed one or more special enterprises. In making a study of the sugar beet, this feature received some attention in the reports prepared on the Utah-Idaho and Colorado areas. Similar figures, obtained by the Census Bureau in 1909, are available for the Michigan and Ohio region. While some changes have undoubtedly taken place since then, sizes that were common at that time constitute some of the important groups at present. (See Table II.) Side by side with the census figures is shown the distribution of the farms visited in this survey:

TABLE II.—*Size and number of farms, and number of records obtained, in Tuscola, Gratiot and Allegan Counties, Mich., and Paulding County, Ohio.*

Acres	Tuscola Co., Michigan.		Gratiot Co., Michigan.		Allegan Co., Michigan.		Paulding Co., Ohio.	
	Number of farms (census).	Number of farm records.	Number of farms (census).	Number of farm records.	Number of farms (census).	Number of farm records.	Number of farms (census).	Number of farm records.
9 and under	91	....	103	....	200	....	124	....
10 to 49	1,486	9	1,327	10	2,233	3	681	1
50 to 99	2,085	63	1,740	19	2,299	10	1,082	40
100 to 174	1,290	49	841	17	1,101	16	701	35
175 to 259	213	9	133	7	233	6	189	14
260 to 499	66	3	54	....	78	1	58	7
500 to 999	10	1	6	....	8	....	4	....
1,000 and above	3	....	1	....	5	5	1	....
		134		53		36		97

According to the census figures of 1909 more than one-third of all Michigan farms were classified in the group size 50 to 99 acres. Nearly one-fourth were placed in the group size 10 to 49 acres, and approximately one-fourth were 100 to 174 acres in size. These three groups include the 40, 80, and 160 acre farms and, together, they constitute about five-sixths of the farms of the State. It will be seen that there is some correspondence throughout in the number of farms that were classified in the group-size 50 to 99 acres. The records obtained from farmers in these regions are representative of the farms found in these areas, so far as size is concerned.

RAINFALL.

The normal rainfall in this region is distributed quite uniformly throughout the year. Table III gives the average monthly and annual precipitation for three districts in Michigan and one district in Ohio. In two of these districts the total annual rainfall for the years 1914 and 1915 is given for a comparison with the averages that are reported. The 1915 annual rainfall for the Paulding area is also given in this connection.

TABLE III.—*Mean annual rainfall for three districts in Michigan and one in northwestern Ohio.*

Month.	Caro District, Arbela, 1887–1908.	Alma District, Alma 1887–1908.	Grand Rapids District, Grand Rapids, 1870–1908.	Ohio District, Paulding, 1883–1908.
	Mean.	*Mean.*	*Mean.*	*Mean.*
January	2.29	2.53	2.69	2.44
February	2.03	1.95	2.33	2.07
March	2.63	2.49	2.65	3.08
April	2.71	2.39	2.49	2.76
May	4.14	3.56	3.25	3.32
June	3.20	3.07	3.92	3.18
July	3.13	3.11	3.17	3.49
August	2.79	2.73	2.67	2.74
September	2.80	3.28	3.42	2.27
October	2.70	2.61	2.76	2.23
November	2.63	2.66	2.85	2.47
December	2.33	2.34	2.65	2.71
Average annual precipitation	33.38	32.74	34.85	32.76
Average annual precipitation, 1914	....	37.63	29.83	....
Average annual precipitation, 1915	....	30.26	28.93	32.78
Elevation	728 feet	730 feet	707 feet	725 feet

There is only a slight variation in normal rainfall in these four districts, the average annual precipitation for the entire area being not far from 33 inches. In the Alma district the rainfall for 1914 was about 5 inches above the average, while in 1915 it was 2.5 inches below normal. In the Grand Rapids region the precipitation was considerably below the average for the two seasons 1914 and 1915.

A study of the prevailing summer temperature for the sugar-beet regions of the United States has shown that an average of 70° F. during the growing period is conducive to the development of a satisfactory sugar content. This condition obtains in the Michigan and Ohio sugar-beet areas.

SOILS.

In Tuscola and Gratiot Counties the soil type that is best adapted to sugar beets, and the one that produces the major portion of this crop, is known as Clyde loam. It is the most extensive type in this region.[1] Clyde loam has been described as a soil that is easily tilled, if cultivated at the proper time, but if worked when too wet or too dry it breaks up into lumps and is apt to remain in a rough condition during the entire season. It is especially well suited to the production of sugar beets, beans, corn, oats, wheat, and hay. In the Grand Rapids area Allegan black clay appeared to be the type upon which the sugar beet was grown most extensively. Clyde clay was the most significant type in the Ohio survey.

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[1] Bureau of Soils report, Saginaw area, 1904; Bureau of Soils report, Allegan County, 1901; Bureau of Soils report, Paulding County, 1904.

CROP ROTATION.

A fairly definite rotation of crops was found in each district visited, depending on local conditions and the crops best adapted to the region. Following is an outline of the typical rotations followed:

Caro and Alma areas:	Grand Rapids area:	Northwestern Ohio area:
Clover and timothy 1 to 3 years.	Clover and timothy 1 to 3 years.	Clover and timothy 1 to 2 years.
Corn 1 year or beans 1 year.	Corn 1 year.	Sugar beets or corn 1 year.
Sugar beets 1 year.	Sugar beets 1 year.	Grain 1 year.
Grain 1 year.	Grain 1 year.	Reseed to clover and timothy.
Reseed to clover and timothy.	Reseed to clover and timothy.	

The Caro and Alma records were combined in the study of crop rotation, because the conditions in these two districts were very similar. The chief difference noted was that in the Alma district the general practice was to follow timothy and clover with corn, while in the Caro district beets or beans are often substituted for corn as the crop to follow timothy and clover.

In the Caro district sugar beets and beans are the two most important competing cash crops. For the year 1915 the sugar-beet and bean acreage was about equally divided. An average of about 15 acres per farm was devoted to each crop. Approximately 9 acres per farm was planted to corn. On 30 per cent of the farms in this district beans followed clover and timothy and preceded sugar beets. On 17 per cent, corn followed clover and timothy and preceded the sugar beet. On 10 per cent, beans were planted after corn and were followed by sugar beets.

Beans did not occupy so prominent a place in the cropping system of the Alma district. However, on those farms where beans were grown the average acreage per farm was 13, while that of sugar beets was 10. An average of 13 acres per farm was devoted to corn. The sugar beet followed corn on 57 per cent of the farms visited; on 25 per cent sugar beets followed beans.

In the Grand Rapids area, where 36 farms were visited, beans were reported on 19 farms and corn on all farms, the average corn acreage being 17. Sugar beets followed corn on 24 farms and beans on 2 farms. The average acreage per farm of beans was 9, while that of sugar beets was 6.

In northwestern Ohio beans were not included in any of the rotations mentioned. Corn appeared in the rotation on every farm and preceded sugar beets on 28 per cent of the farms in this district. (See fig. 3.) The average acreage of corn per farm was 33. The average acreage devoted to sugar beets was 16. On 39 per cent of these farms, the sugar beet followed a crop of clover. Occasionally sugar beets follow a crop of alfalfa. (See fig. 4.)

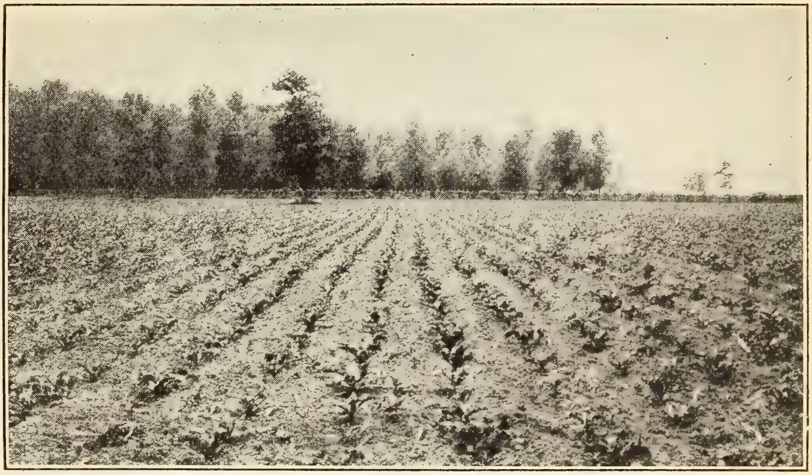

Fig. 3.—Sugar beets followed corn in the rotation in northwestern Ohio.

There was a striking similarity in the general arrangement of the cropping systems in all of these districts. It was the general practice to grow beets once in the rotation; this intertilled crop was then changed to another field. Clover was utilized in every district to add nitrogen to the soil and keep up the humus content. Timothy was usually grown with the clover. The major differences noted were the absence of beans in the rotation in Ohio, and the tendency of

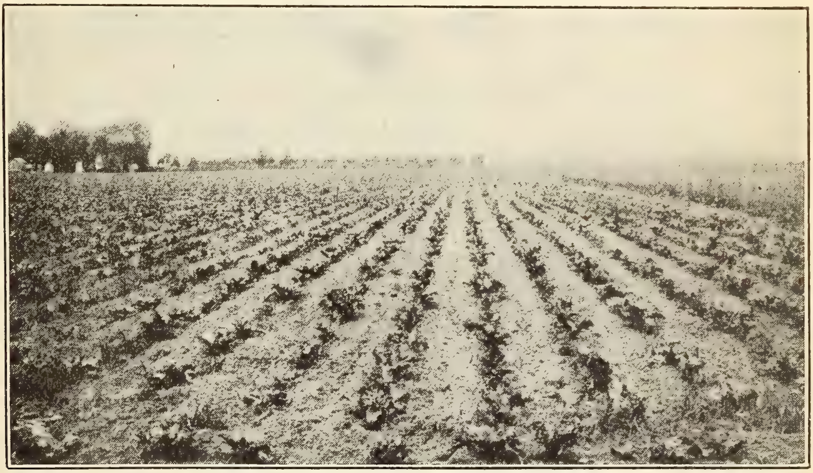

Fig. 4.—Sugar-beet growing on land that was in alfalfa during the preceding year. Occasionally sugar beets follow a crop of alfalfa.

farmers there to follow a crop of clover with sugar beets. This latter practice seems to be a commendable one.

MAN AND HORSE LABOR.

In calculating the 1915 costs reported for the various operations discussed here, a rate of 20 cents per hour was used for the man labor and 10 cents per hour for the horse labor. A few enterprise records secured in the Caro district for the crop year 1914 were worked out with a rate of 16 cents per hour for the man labor. The horse rate was the same as that for the year 1915. In view of the fact that a limited number of records entered into the 1914 determination, the lower man-hour rate that obtained did not appreciably influence the average rate. The latter was about 19 cents per hour. The prevailing rates for regular and extra labor were used in working out the standard rates that have been indicated. Contract labor will be treated under a separate paragraph.

FARM PRACTICES IN GROWING SUGAR BEETS.

THE USE OF MANURE.

Sugar-beet operators in these areas appreciate the value of farm manure. They know that it is essential, not only to keep up the soil fertility, but also to add humus and thereby maintain a good physical condition. Three hundred and twenty farmers were interviewed in these districts. The sugar beets on 201 farms received a benefit from an application of manure. Of this number, 45 per cent applied manure directly to sugar-beet land, 30 per cent to corn land, 14 per cent to bean land, and 2 per cent to meadow land. In northwestern Ohio, where 97 farmers were visited, only 32 per cent applied manure. However, 36 per cent plowed under either a crop of clover or clover sod. The latter practice did not prevail in any of the other districts visited. In each of the three other districts approximately 75 per cent applied manure. Where manure was applied directly, 50 per cent of the estimated value was charged to the sugar beet; if applied to a crop immediately preceding, 30 per cent was charged, and if two other crops preceded the beet, 20 per cent was charged.

Most of the manure hauling was done during the late fall and early spring months, at a season of the year when there was little field work requiring the attention of the farmer. Fifty-one per cent of the manure was applied with a crew consisting of one man and two horses. Twelve per cent of the farmers used a 1-man and 3-horse crew; on 16 per cent of the farms a 2-man and 2-horse crew was used.

The average amount of manure applied per acre was fairly uniform for all districts studied, but the amount applied per acre on individual farms showed considerable variation (Table IV). The latter ranged from 4 tons to 30 tons per acre.

The average labor requirements and cost per acre of hauling were also quite uniform. However, the amount of labor and the cost per acre on individual farms showed considerable variation. This variation may be explained largely by the amount of manure applied per acre and the kind of implement used in hauling. The lowest labor cost per acre was found in the Caro district, where a charge of 90 cents was made for a 4-ton application. The highest labor cost, $9.50 for a 30-ton application, was reported in northwestern Ohio.

TABLE IV.—*Use of manure, average by districts.*

District.	Per cent of all records	Acres in beets.		Tons per acre.	Hours of labor per acre.		Labor cost per acre.
		Total.	Manured.		Man.	Horse.	
Caro	75	15.46	8.00	12.87	9.03	16.58	$3.33
Alma	75	9.74	6.23	14.30	11.19	19.91	4.23
Grand Rapids	72	6.27	4.41	13.13	7.94	18.30	3.42
Northwestern Ohio	32	15.24	6.55	13.94	10.20	20.69	4.11

The manure spreader was used on 135 farms and the wagon on 56 farms. On 10 farms the implement used was not indicated. The capacity of the manure spreader ranged from 50 to 100 bushels, with an average of about 75 bushels.

An examination of the estimates reveals the fact that the farms using wagons to haul manure average 20 per cent smaller than those using spreaders. In many instances farms using wagons exclusively are too small and the amount of manure to be hauled too limited to warrant the purchase of a manure spreader. It has been demonstrated that the application of manure by means of a manure spreader is the best method, not only in time required to do the work, but also in respect to the quality of the work done. It would seem that two or more farmers on adjacent small farms might purchase a manure spreader to be used jointly to the advantage of each.

Undoubtedly stable manure is the best fertilizer for general use with sugar beets, but on most farms the supply is limited, making it advisable to supplement the barn-yard manure with an application of commercial fertilizer to the beet land. Sixty-eight per cent of the farmers in the Caro, 47 per cent in the Alma, 78 per cent in the Grand Rapids district, and 39 per cent in northwestern Ohio applied commercial fertilizer. It will be noted that the use of fertilizer and stable manure in northwestern Ohio was not so extensive as in the other districts visited. The general practice in northwestern Ohio is to depend to a greater extent for the maintenance of soil fertility on sugar-beet land on the practice of systematically plowing under a clover crop. Twenty-nine per cent of the men in the Caro, 32 per cent in the Alma, and 56 per cent in the Grand Rapids district, and only 5 per cent in northwestern Ohio applied both manure and commercial fertilizer. With very few exceptions, the growers who applied commercial fertilizers covered their entire beet acreage, even though a portion of the acreage had received an application of manure.

Beet drills with fertilizer attachments were used to apply the fertilizer in the drill row at the time of seeding, so that the labor requirements for fertilizing are included under planting practice.

A majority of the men interviewed reported a special trip to town after fertilizer. The labor cost for hauling amounted to about 20 cents per acre. The rate of application ranged from 130 pounds to 170 pounds per acre and consisted in most cases of a prepared mixture containing about 2 per cent nitrogen, 8 per cent phosphoric acid, and 3 per cent potash. The cost per acre for the above application ranged from $1.75 to $2.

PLOWING.

Sugar beets require a well-prepared, deep, firm seed bed. To obtain this the land should be in good condition at the time of breaking and the depth of plowing should be sufficient to allow the long taproot of the sugar beet to penetrate some distance into the soil. The depth of plowing varied from 6 inches to 9 inches, with an average depth of about 7.5 inches for all districts studied. (Table V.)

It is generally conceded that fall plowing of sugar-beet land is to be preferred, and this was found to be the practice on a considerable number of the farms visited.

In the Caro district 56 per cent of the men reported fall plowing, 20 per cent spring plowing, and 24 per cent did a portion of the work in the fall and the remainder in the spring. A small proportion practiced fall plowing in the other districts, but this was mainly because of lack of time to do the work before cold weather set in. The spring plowing was all done early in April, or as early as the land was in condition to work.

TABLE V.—*Plowing.*

District.	Per cent of all records.	Acres in beets per farm.		Hours of labor per acre.		Labor cost per acre.
		Total.	Plowed.	Man.	Horse.	
Caro	96	14.94	14.54	5.77	14.34	$2.50
Alma	92	9.44	9.21	4.85	11.87	2.16
Grand Rapids	100	6.40	6.40	5.19	13.52	2.39
Northwestern Ohio	100	15.64	15.29	5.69	14.58	2.60

Six men in the Caro and four in the Alma district reported on the practice of planting beets after beans without plowing. In the cases where the plowing was omitted the disk and spring-tooth harrow were substituted for the plow in the preparation of the seed bed. Very good results, where the land was free from weeds, were reported by this method.

Two common types of plows were observed, the common moldboard walking plow (fig. 5) and the one-way sulky plow. Two hundred and twenty-five walking, 76 riding, and 7 two-furrow gang plows were reported. The walking plows ranged in width from 12 to 14 inches, and the sulky plows were practically all 14 inches in width. Three-horse teams were used almost exclusively with sulky plows (fig. 6), while with the walking plow not only the 2-horse but also the 3-horse team was used. Forty-eight per cent of the men used a 1–3 crew and were able to cover an acre of ground in an average of 5.2 hours, while the 47 per cent who used a 1–2 crew required 6.1 hours per acre. The width of implement ranged from an average of 12.7 inches for the 1–2 crew to 13.2 inches for the 1–3 crew. Five per cent used a 1–4 crew and plowed an acre in an average of 3.4 hours. Mainly two-bottom 12 to 14 inch gang plows were used with the latter crew.

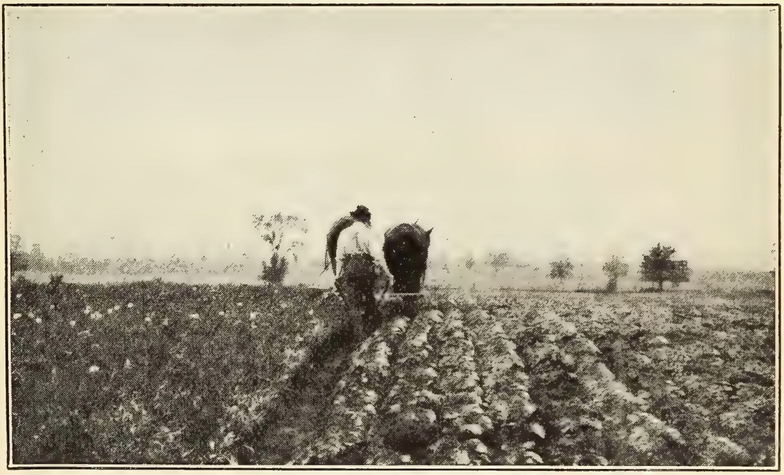

FIG. 5.—A crew of one man and two horses breaking land with a walking plow. This was a common type in these districts.

One grower in the Alma district used a two-bottom 12-inch gang plow drawn by a tractor. With one man to operate this outfit, plowing was done at the rate of 1 acre in about 3½ hours.

DISKING.

The disk harrow, or pulverizer, as it is commonly called, is often used in preparing a seed bed for the sugar beet. Disking destroys weeds which may be present on fall-plowed land and breaks up surface clods. The seed bed should also be compact and free from hard lumps. The disk harrow by means of its sharp blades pulverizes and fines the lower portion of the seed bed, which allows free circulation of air and enables the delicate rootlets of the sugar beet to penetrate all portions of the soil in search of plant food. Disking is especially desirable on spring-plowed land which has not had the advantage of the freezing and thawing action of the preceding winter. It is an important factor in breaking up clods and firming the soil (fig. 7).

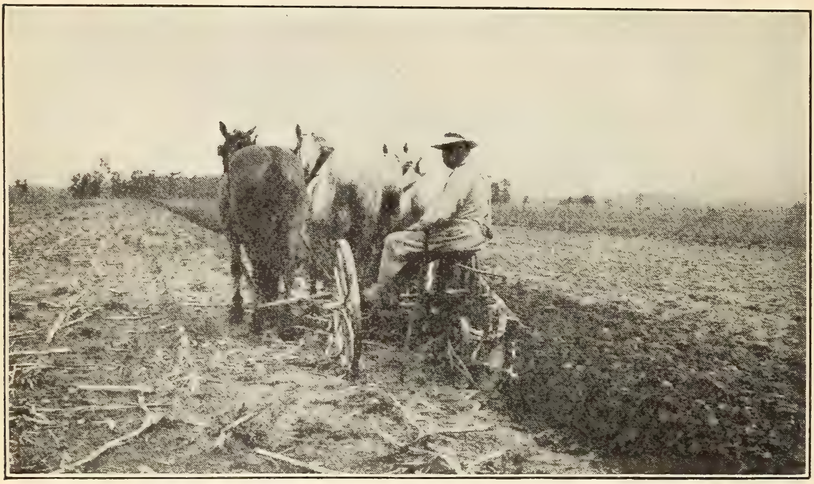

FIG. 6.—Plowing with a sulky. Three-horse teams were used almost exclusively with sulky plows.

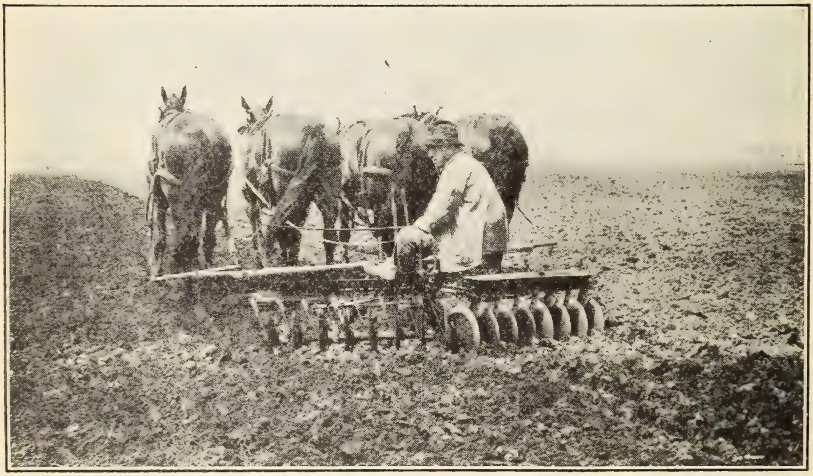

FIG. 7.—Disking is an important factor in breaking up clods and firming the soil.

The disk harrow was not used to so great an extent in the Alma and Grand Rapids districts. In these two areas the work of pulverizing the soil was done largely by means of the spring-tooth harrow.

Disking in all districts was done early in April. Few double-action disks were recorded in any section except northwestern Ohio, where 23 were found. This type has two sets of disks, one in front of the other, and is so adjusted that the front set throws the dirt out while the rear set throws it in, leaving the ground practically level. Because of the double row of disks the land is disked twice each time that the ground is gone over.

A crew of 1 man and 4 horses was used with the double-action disk. A 1-man and 3-horse crew was typical for the single-action disk. However, a 1-man and 2-horse crew was reported on several farms. The width of the implement varied from 5 to 8 feet. The average width for all districts was about 6 feet.

The average cost per acre was fairly uniform, with the exception of the Grand Rapids area, where the cost was slightly higher than that of the other districts (Table VI).

TABLE VI.—*Disking.*

District.	Per cent of all records.	Acres in beets per farm.		Times disked.	Hours of labor per acre.		Labor cost per acre.
		Total.	Disked.		Man.	Horse.	
Caro	56	16.50	15.70	2.85	3.48	8.88	$1.51
Alma	36	10.55	10.32	1.88	2.18	5.64	1.00
Grand Rapids	28	8.58	8.48	2.60	3.50	12.21	1.92
Northwestern Ohio	68	15.35	14.68	2.39	2.45	7.71	1.26

DRAGGING.

The principal object to be attained in the use of a planker or drag is to break up surface lumps. This is a homemade implement constructed from planks which are lapped one upon the other forming a ridged undersurface. When this surface comes in contact with the soil it creates a grinding, pulverizing action which smooths and slightly compacts the soil and fills in depressions. The records indicate that it was used principally just ahead of the drill. The width varied from 6 to 10 feet, with an average width of approximately 8 feet. It is a common practice to place a piece of railroad iron or other heavy weight on the float. Sometimes the operator rides to give it additional weight.

A typical crew for this operation consisted of one man and two horses. Eighty-one per cent of the farmers used a crew of this size, 16 per cent used a 1-man and 3-horse crew, and 3 per cent a 1-man and 4-horse crew. The average cost per acre for one operation was fairly uniform. On individual farms for one operation the lowest cost was 20 cents and the highest 68 cents per acre. (See Table VII.)

TABLE VII.—*Dragging.*

District.	Per cent of all records.	Acres in beets per farm.		Times dragged.	Hours of labor per acre.		Labor cost per acre.
		Total.	Dragged.		Man.	Horse.	
Caro	45	13.01	12.74	1.09	0.97	2.06	$0.39
Alma	74	9.56	9.17	1.51	1.56	3.42	.65
Grand Rapids	33	6.27	6.02	1.25	1.22	3.18	.56
Northwestern Ohio	45	14.73	13.95	1.16	1.06	2.50	.46

HARROWING.

Two types of harrow were used in each district, viz, the spike-tooth and the spring-tooth. The spike-tooth harrow stirs the soil to a moderate depth and is the implement commonly used to create a smooth, even surface. Seventy-nine per cent of the growers interviewed used this type of harrow.

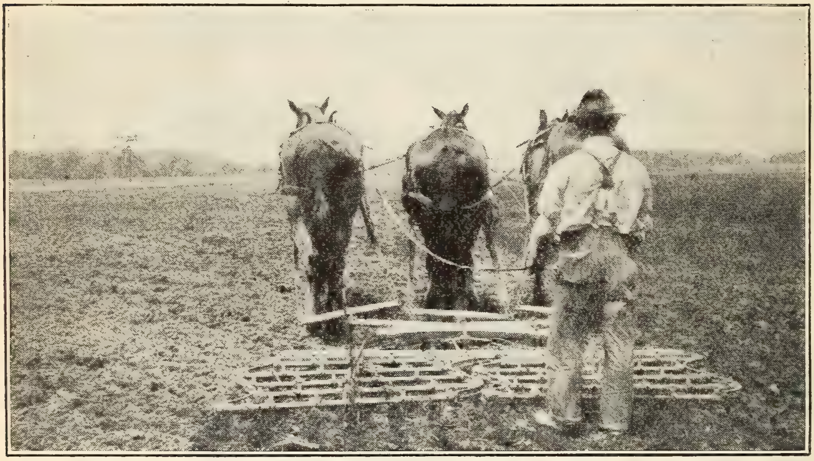

FIG. 8.—Harrowing with a spike tooth. This implement stirs the soil to a moderate depth and is commonly used to create a smooth, even surface.

The width of the implement varied from 8 feet to 16 feet, with an average of about 9 feet. Fifty-nine per cent used a 1-man and 2-horse crew. This crew size predominated in all sections except northwestern Ohio. In this area the width of harrow averaged about 10 feet, and 40 per cent of the men used a crew of one man and three horses. (See Table VIII.)

TABLE VIII.—*Harrowing (spike-tooth).*

District.	Per cent of all records	Acres in beets per farm.		Times harrowed.	Hours of labor per acre.		Labor cost per acre.
		Total.	Harrowed.		Man.	Horse.	
Caro	70	15.92	15.56	1.49	1.09	2.33	$0.43
Alma	87	9.80	9.31	1.76	1.23	2.77	.53
Grand Rapids	67	7.20	6.95	1.38	1.09	2.69	.49
Northwestern Ohio	91	16.40	16.30	1.87	1.49	3.74	.67

The average labor requirements and cost per acre were fairly uniform, but there was considerable variation on individual farms.

The spring-tooth harrow stirs the soil to a greater depth than the spike-tooth, brings clods to the surface (see figs. 9 and 10), and was used extensively in all districts, although not to so large an extent in northwestern Ohio as in the other three sections. This operation was performed on 252 farms. (See Table IX.)

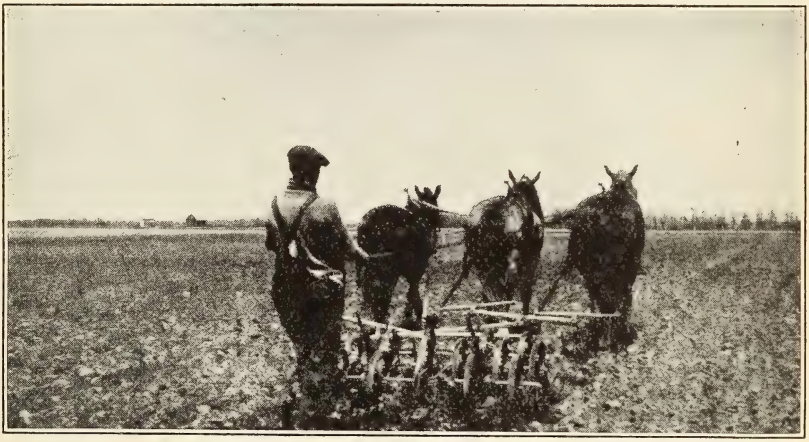

FIG. 9.—One man and three horses harrowing with a spring tooth. This was a common crew in the regions or districts visited.

TABLE IX.—*Harrowing (spring-tooth).*

District.	Per cent of all records.	Acres in beets per farm.		Times harrowed.	Average crew.		Hours of labor per acre.		Labor cost per acre.
		Total.	Harrowed.		Man.	Horse.	Man.	Horse.	
Caro	90	14.06	14.06	3.07	1.0	2.5	3.44	8.65	$1.51
Alma	96	9.58	9.50	3.15	1.0	2.6	3.66	9.05	1.63
Grand Rapids	94	5.75	5.75	3.50	1.0	2.9	3.64	10.34	1.76
Northwestern Ohio	47	15.98	14.72	1.58	1.0	2.9	1.82	5.01	.86

The average width of implement was approximately 6½ feet. Forty-four per cent of the men interviewed used a crew of one man and two horses. On 43 per cent of the farms a 1-man and 3-horse crew was used. The crew of one man and two horses predominated in the Caro and Alma districts, while the 1-man and 3-horse crew was in the majority in the Grand Rapids and Ohio districts.

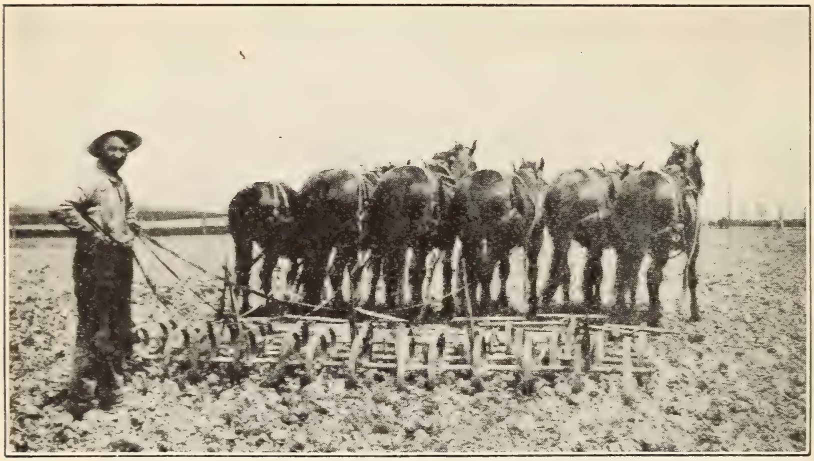

FIG. 10.—A crew of one man and six horses operating a spring-tooth harrow. More horses are used here than in the average crew. (See Table IX.)

ROLLING PRACTICE.

Two general types of rollers were found in these districts; the solid smooth drum roller (fig. 11), either steel or wood, and the bar roller or pulverizer. (fig. 12). Two hundred and thirty-one smooth iron, 37 bar, and 18 wood rollers were reported. The average width of these implements was about 8 feet. (See Table X.)

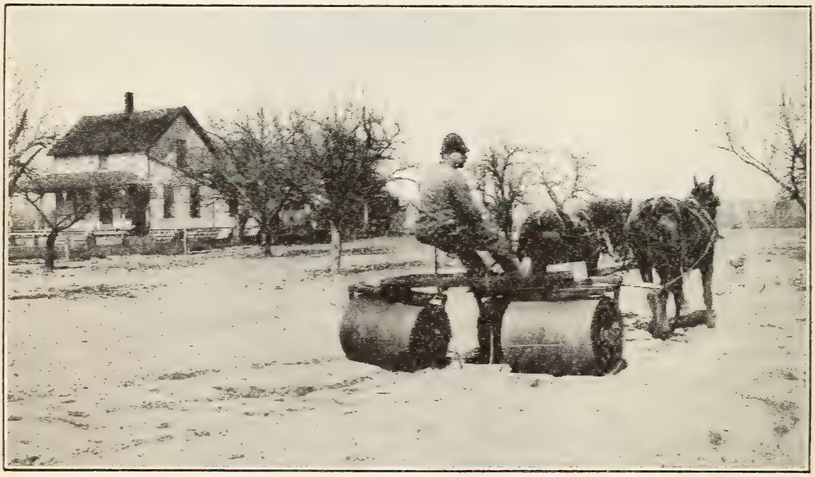

FIG. 11.—Rolling with a smooth drum roller. This type crushes clods and leaves a smooth surface.

TABLE X.—*Rolling.*

District.	Per cent of all records.	Acres in beets per farm.		Times rolled.	Hours of labor per acre.		Labor cost per acre.
		Total.	Rolled.		Man.	Horse.	
Caro	93	15.15	15.06	2.17	1.63	3.26	$0.63
Alma	98	9.53	8.95	2.36	1.87	3.74	.74
Grand Rapids	78	5.92	5.92	1.91	1.48	2.96	.60
Northwestern Ohio	85	16.69	15.71	1.84	1.40	2.80	.56

Sixty-six per cent of the men in the Caro district, 87 per cent in the Alma, 78 per cent in the Grand Rapids district, and 44 per cent in northwestern Ohio rolled prior to or immediately after planting. The average number of times the land was rolled ranged from 1.4 to 1.9.

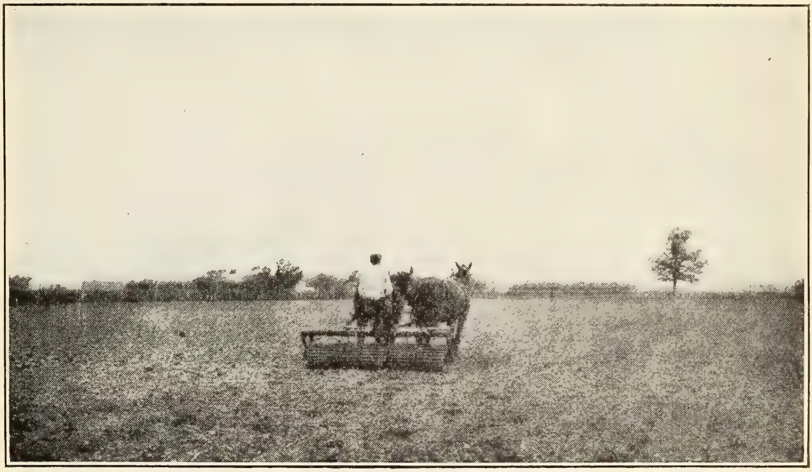

FIG. 12.—Rolling with a bar roller. This implement firms and also pulverizes the soil.

The majority of the men rolled immediately before planting, some after planting, and a few rolled both before and after seeding. The object of rolling before seeding was to create a smooth even surface for the drill rows. Still other men used the roller along with the harrow and disk in the general work of preparing a suitable seed bed.

Fifty-four per cent of the men in the Caro district, 64 per cent in the Alma, 19 per cent in the Grand Rapids district, and 63 per cent in northwestern Ohio rolled at about the time the beets were pushing through the ground, or soon after. Rolling at this time, called "rolling beets," may be done for several reasons. If the rain has caused a crust to form at a period when the seed is germinating, it is customary to employ a bar roller to break the crust, thus allowing the young plants to push through to the surface. This condition often prevails on the heavier soil types. Again, after blocking and thinning it is often advisable to use a roller to smooth the surface and to firm the soil around the young and tender plants.

The average labor requirements and cost per acre were practically the same, regardless of whether the work was done before or after planting.

The cost per acre for one time over on individual farms ranged from 20 cents to 50 cents per acre. The use of a 1-man and 2-horse crew was universal in all districts studied.

PLANTING.

Planting covered a period from April 5 to June 1. Most of the work, however, was done during a period extending from April 20 to May 20. In a few instances, where the seed was planted on sandy soil, wind storms blew it out and it was necessary to replant a fractional part of the acreage. These areas were so small, however, that no charge has been included for seed used in replanting. (See Table XI.)

Table XI.—*Planting.*

	Per cent of all records.	Acres planted per farm.	Hours of labor per acre.		Labor cost per acre.
			Man.	Horse.	
Caro	100	15.13	1.10	2.13	$0.41
Alma	100	9.54	1.12	1.92	.41
Grand Rapids	89	6.80	1.19	1.98	.44
Northwestern Ohio	99	15.77	1.02	2.04	.40

The seed was purchased from the sugar companies, at a cost of 15 cents per pound. The average rate for seeding for all areas was 15 pounds per acre. A few men used a little less, a few more. The lowest amount reported was 9 pounds and the highest 22 pounds per acre. On four farms in the Grand Rapids district the seed was sown with a hand drill at a cost of 73 cents per acre. One farmer in northwestern Ohio hired another operator to do the planting. These farms are not included in the table.

The seed is planted in continuous, solid rows to insure a good stand. Later, when the seed has germinated and the young plants have pushed through the ground, they are thinned out to a suitable distance. This operation will be discussed under a separate heading. Seed was planted at a depth of from one-half to 1 inch.

Ordinary grain drills and special beet drills (fig. 13) were used to do the planting. Where grain drills are used all the hoes are removed except the ones distributing the seed, and they may or may not be equipped with press wheels. The special beet drills are of two sizes; the 2-row and the 4-row drill, each of which has press-wheel attachments which exert a uniform pressure on the drill row. This firms the soil and aids in retaining sufficient moisture to insure a quick germination of the seed. The use of grain drills for seeding was common in three sections. Forty-four drills were reported at Caro, 5 at Alma, and 11 in the Grand Rapids area. In northwestern Ohio special 4-row beet drills were used exclusively. The custom in this area has been for the sugar companies to rent beet drills to the farmers at a nominal charge of 15 cents per acre.

In northwestern Ohio 20-inch rows were found on all farms with the exception of four, where 24-inch rows were reported. In all other districts the width of row varied from 20 inches to 28 inches.

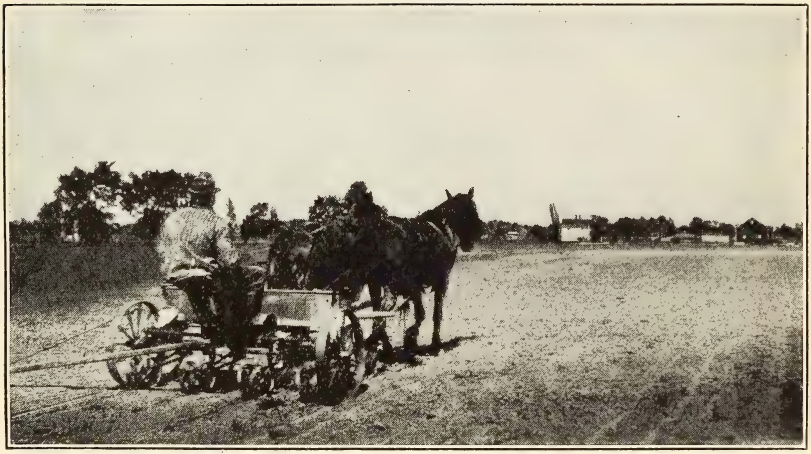

FIG. 13.—Planting seed with a special beet drill.

One-horse 2-row drills were used only in the Grand Rapids and Alma areas. Nine men in the Alma district and 7 at Grand Rapids used this type of drill. The labor charge for seeding on these farms was 55 cents per acre, while the men in the same areas who used a 2-horse, 4-row drill performed the work at a labor cost of about 40 cents per acre.

CULTIVATING.

Sugar beets in these areas were cultivated an average of about five times. The first cultivation occurs as soon as the rows can be seen plainly. The cultivator is equipped with knives or crowfeet for killing weeds. Blocking and thinning usually follow the first cultivation. All subsequent cultivations are usually made with bull-tongue attachments, which stir the soil to a greater depth and create a dust mulch. If weather conditions permit, it is customary to run the cultivator at frequent intervals until the beets are so large that it is impossible to follow the rows. (See Table XII.)

In the Ohio district either the 2-row walking or the 4-row riding cultivator was used. In other districts the 1-row or 2-row riding or walking cultivator was used (figs. 14 and 15). It has been the custom of the Ohio sugar companies to rent 2-row walking cultivators at a charge of 25 cents per acre for the season to sugar-beet farmers desiring them.[1]

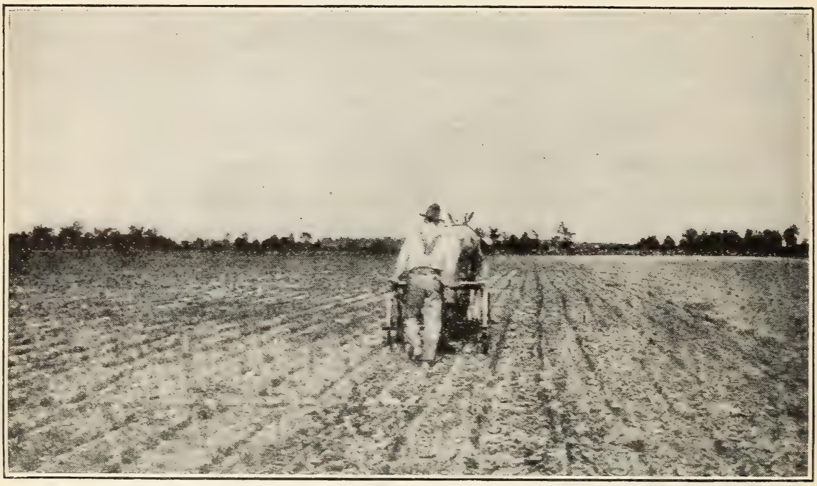

FIG. 14.—Cultivating sugar beets with a 2-row walking cultivator.

TABLE XII.—*Cultivating.*

District.	Per cent of all records.	Acres per farm cultivated.	Times cultivated.	Hours of labor per acre.		Labor cost per acre.
				Man.	Horse.	
Caro	69	13.20	4.58	9.05	9.05	$2.56
Alma	89	9.30	6.20	11.55	11.55	3.47
Grand Rapids	83	6.09	4.88	11.92	11.92	3.57
Northwestern Ohio	81	13.21	4.00	7.56	7.56	2.27

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[1] The type of cultivator used was a factor that caused the comparatively high labor requirement for cultivation in these districts, as may be seen by reference to the following table, which gives a record of the work by a 1–1 crew with a 2-row cultivator in comparison with work done by a 1–2 crew operating a 4-row cultivator.

Labor requirements for cultivating in northwestern Ohio.

Crew.	Records.	Row.	Times over.	Hours per acre.		Labor cost per acre.
				Man.	Horse.	
1 man–1 horse	79	2	4.0	7.56	7.56	$2.27
1 man–2 horses	20	4	4.1	3.86	7.72	1.54

It will be seen that there was a difference here of 3.7 hours of man labor in favor of the 4-row cultivator. The difference in cost amounted to 73 cents per acre.

In addition to the records indicated in Table XII, 82 men were visited who used a 1-man, 2-horse crew. The average beet acreage per farm in this group in the Caro and Ohio districts was from 29 per cent to 49 per cent larger than in the same areas where a 1-man, 1-horse crew was used.

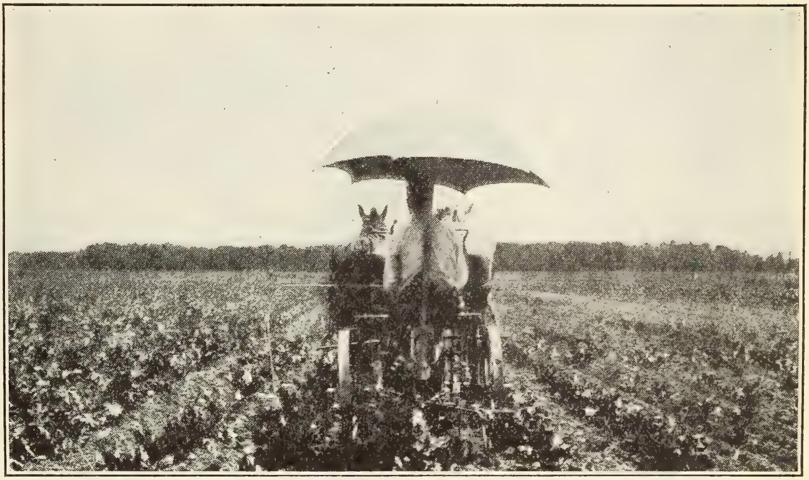

FIG. 15.—Cultivating sugar beets with a 2-row riding cultivator.

HAND WORK ON SUGAR BEETS.

This labor consists of blocking, thinning, usually hoeing twice, pulling, topping, and throwing into piles. Very few farmers have sufficient farm labor to do the hand work, and therefore in most cases it is done by special beet workers at a stipulated contract rate per acre. In addition, the farmer agrees to furnish the beet workers a house to live in (fig. 16), haul fuel, and furnish transportation to and from the railroad station. The beet workers furnish all necessary hoes and knives.

Common contract rates for hand labor in Michigan and Ohio.

Kind of work.	22-inch rows.	24-inch rows.	28-inch rows.
Blocking and thinning	$6.00	$5.00	$5.00
Hoeing, 2 times	3.00	3.00	3.00
Topping and piling	9.00	8.00	7.00
Total	18.00	16.00	15.00

In the Alma area the rates for hand labor were slightly greater than the above. The rate for beets planted in rows 18 inches to 22 inches apart was $20. For beets 24 inches apart the rate was $18 per acre, and for beets 28 inches apart, $16 per acre.

BLOCKING AND THINNING.

As pointed out under planting practice, the beet seed is drilled in solid rows to insure a good stand. Therefore the young beets must be thinned in order to provide sufficient space for the growth and development of the plants allowed to remain. The proper time to block and thin is just as soon as possible after the young plants are up and the rows can be plainly seen. (See fig. 17.)

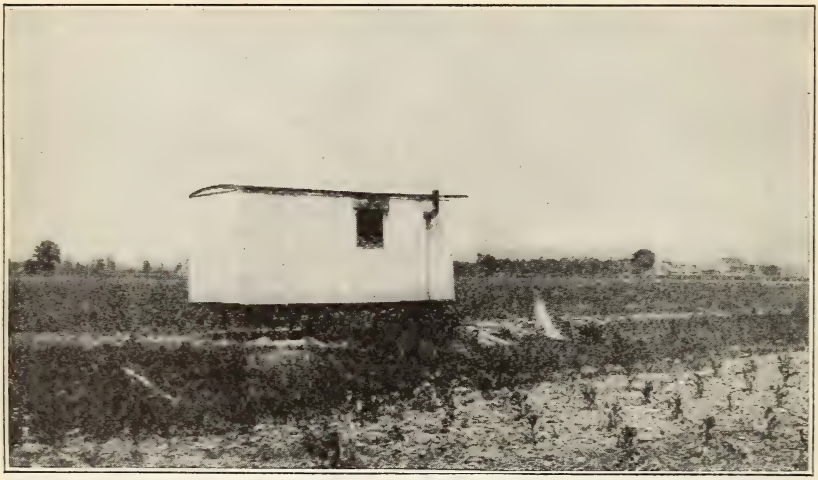

FIG. 16.—Temporary movable quarters provided for labor doing the handwork on the beet crop.

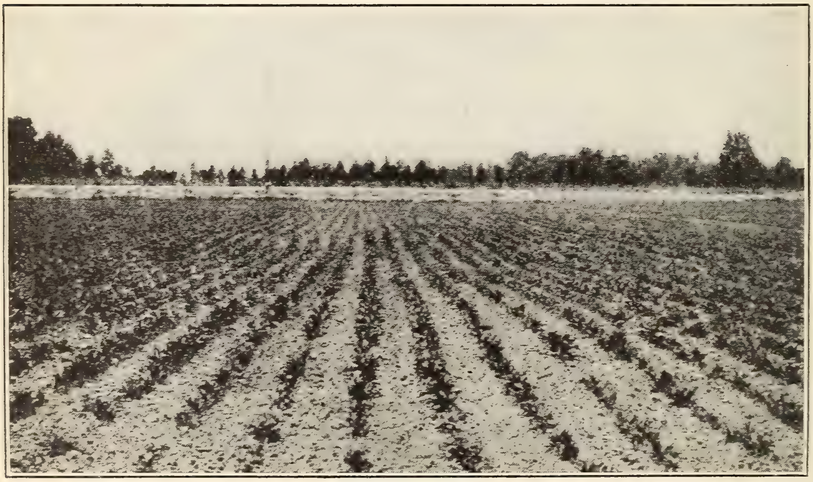

FIG. 17.—Sugar beets that were not thinned at the proper time. This work should be done as soon as the young plants are up and the rows can be seen plainly.

The blocking consists of hoeing out all of the surplus plants and leaving a small bunch of beets at regular intervals in the row. The thinning should be carefully performed so that only one plant is left in a place and in a manner which will result in retaining the strongest plants evenly distributed throughout the length of the row. For the men who gave estimates on this operation, the spacing was from 9 to 12 inches apart in the row.

Fifteen per cent of the farmers did the blocking and thinning with their own farm labor. The average labor requirements per acre varied from 25 to 36 hours and cost from $5 to $7.50 per acre.

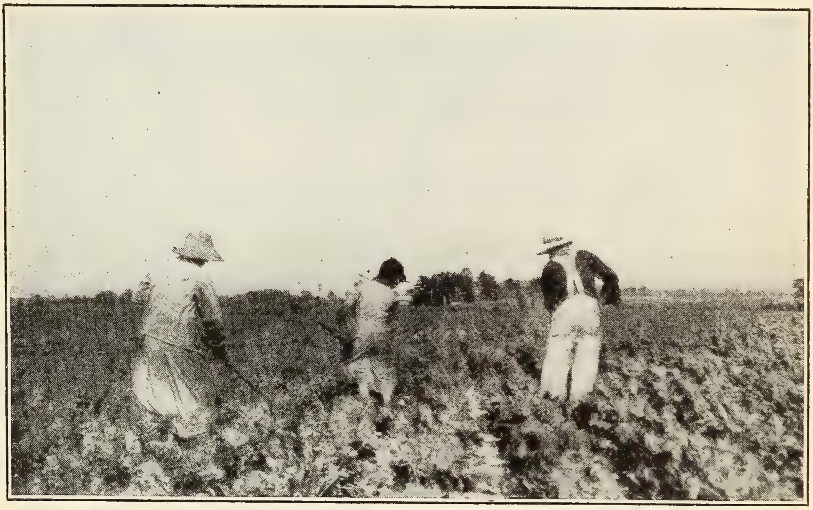

FIG. 18.—Hoeing sugar beets after the crop has made considerable growth.

HOEING.

The agreement for contract hand labor stipulates that the beets shall be hoed twice and shall be kept free from weeds in the row and for a distance of 3 inches on each side of the row. (See fig. 18.)

TABLE XIII.—*Hoeing.*

Districts.	Number of records.	Acres in beets per farm.		Times hoed.	Man hours per acre.	Labor cost per acre.
		Total.	Hoed.			
Caro	13	8.82	8.59	1.48	17.17	$3.13
Alma	21	7.65	7.65	1.09	17.80	3.56
Grand Rapids	25	4.36	4.36	1.22	27.67	5.53
Northwestern Ohio	16	16.49	10.89	1.00	9.60	1.92

The contract rate for two hoeings was $3 per acre. It will be noticed (Table XIII) that the cost per acre in three districts where the hoeing was done by the farm labor was more than the contract rate, while in the Ohio district it was considerably less. The amount of work that can be accomplished in a given time is exceedingly variable, since so much depends on the number of weeds present.

Again, in Ohio the farmers did a portion of the hand labor and contracted the remainder. Hence the number of acres hoed per farm was less than the acreage planted to beets.

Seventeen per cent of the farmers did the work of hoeing with their own labor. The average number of times hoed per farm varied from one to one and one-half times.

LIFTING.

The beets are ready to be lifted or to be "plowed out" just as soon as they are mature. The time is determined by a sugar test made by the sugar-factory representative. The lifting period extends from about the middle of September until December 1. (See Table XIV.)

TABLE XIV.—*Lifting.*

District.	Per cent of all records.	Acres in beets per farm.		Hours of labor per acre.		Labor cost per acre.
		Total.	Lifted.	Man.	Horse.	
Caro	100	15.06	15.03	4.60	10.61	$1.91
Alma	100	9.54	9.54	4.14	8.35	1.66
Grand Rapids	100	6.40	6.14	4.44	8.88	1.78
Northwestern Ohio	100	15.82	15.77	4.49	9.06	1.80

Two types of implements are used in doing the work, the crotch lifter (fig. 19) and the side lifter. The crotch lifter consists of two bowed standards, each of which is equipped with a sharp projecting point, while the side lifter has only one point on the end of a long, thin cutting-blade. The points of the crotch lifter run on either side of the row, while that of the side lifter runs on one side only. The beets are loosened and slightly raised, from which position they are easily pulled and thrown into piles. The side lifter has a lighter draft and is the type usually found in these regions. The crotch lifter was found on only 49 farms.

The typical crew for all sections except the Caro district consisted of 1 man and 2 horses. There were 43 men in the latter district who used a 1-man and 3-horse crew. Slightly less than 2 acres constituted a day's work. However, it was customary to lift only enough beets at one time to keep the hand labor busy.

TOPPING.

This operation goes hand in hand with lifting and hauling. After being loosened with a lifter the beets are then removed by hand (fig. 20) and the tops cut off squarely with a heavy beet knife, just under the lowest leaf scar. It is essential that all green portions of the crown be removed in the field. The crown contains salts which interfere with sugar extraction, so that if the beets are not properly topped a deduction for such beets is made on delivery to the factory or loading station. When topped they are placed in piles consisting of the beets from 16 to 18 rows. The piles must be at least 2 rods apart and must be covered with tops each night.

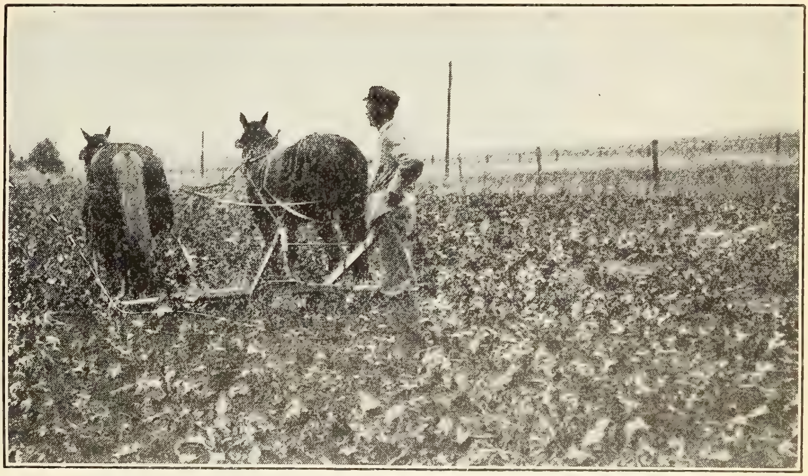

FIG. 19.—Harvesting beets with a lifter. The points of the crotch lifter run on either side of the row.

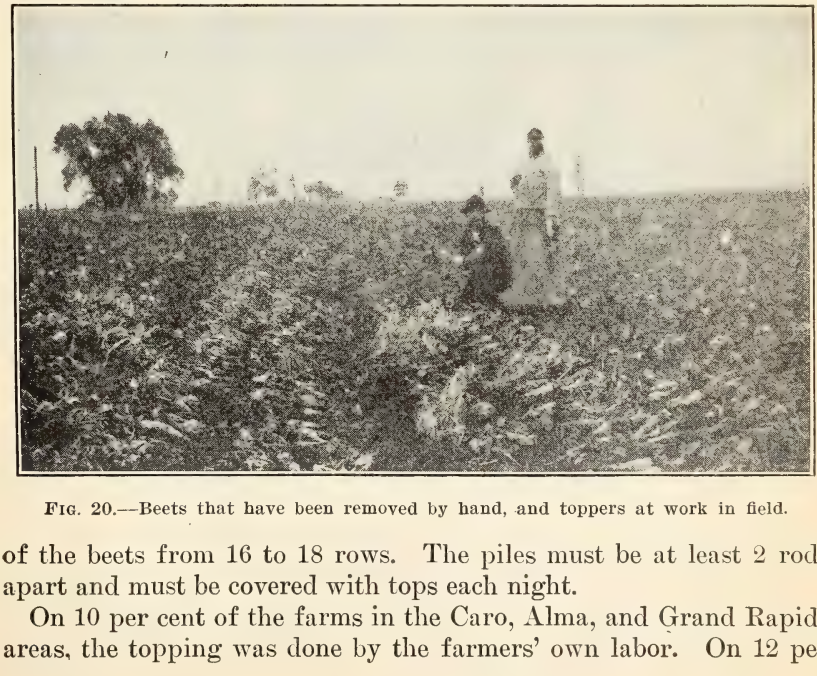

FIG. 20.—Beets that have been removed by hand, and toppers at work in field.

On 10 per cent of the farms in the Caro, Alma, and Grand Rapids areas, the topping was done by the farmers' own labor. On 12 per cent of the farms in Ohio the farmer did a portion of the work and had the remainder done by contract labor. The labor requirements on farms when the topping was not contracted ranged from about 23 to 28 hours per acre and the labor cost varied from $4.65 to $5.60 per acre. It will be seen that the farmer performed the labor of topping at an appreciably lower cost per acre than the contract rate.

HAULING.

The sugar beets are forked into large beet boxes from piles in the field. From the field they are either hauled to a loading station (see fig. 21), where they are loaded into cars, or directly to the sugar-factory beet dump. Upon arrival at the loading station or factory, as the case may be, a representative sample is taken and weighed as it comes from the load. All dirt is removed. The sample of beets is retopped when necessary and the clean sample is weighed a second time. The difference in weight represents the tare. In all sections, with the exception of northwestern Ohio, the loading of beets into cars was done by hand. At one place in northwestern Ohio several mechanical loading devices were observed. (See Table XV.)

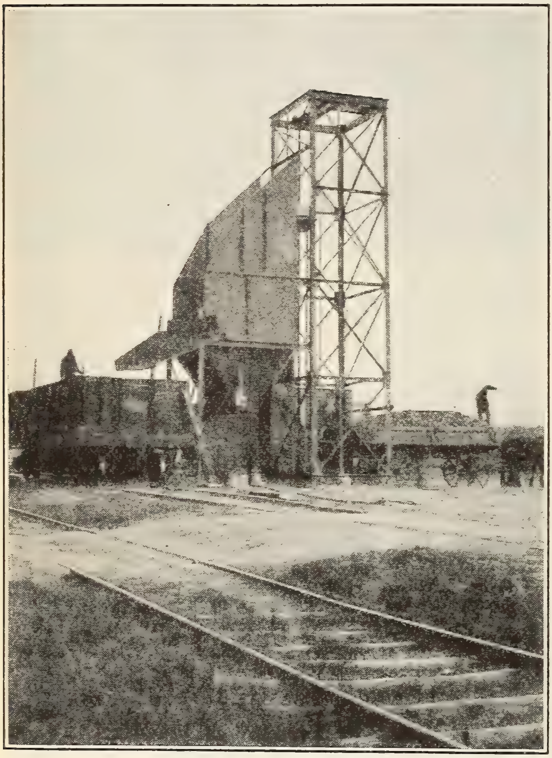

FIG. 21.—A typical loading station in northwestern Ohio. Here the beets are placed in cars and are then transported to the factory.

In northwestern Ohio five men hired the hauling done at a contract rate of from 65 cents to 80 cents per ton, depending on the distance hauled. In all other districts the hauling was done by the farmers' own labor. The weight of load ranged from 1½ to 2½ tons.

The size of the load is an important factor in determining the hauling cost per ton. By comparing the records which were obtained in the Alma district with the records which were secured in the Grand Rapids area it is found that the average load in the former area was seven-tenths of a ton greater than the average load in the latter area. In other words, the Alma operators hauled an average load of 3.1 tons, whereas the Grand Rapids growers took in only 2.4 tons per load.

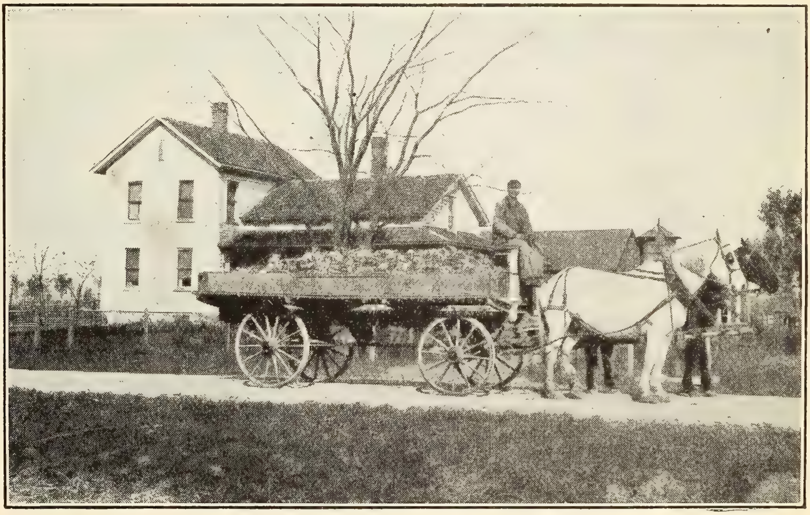

FIG. 22.—Hauling sugar beets with a crew of 1 man and 2 horses. This illustrates the common crew for these regions.

The hauling season extended from about September 15 to early in December. A 1-man, 2-horse crew (fig. 22) was used in all districts except Grand Rapids, when five men used a 1-man, 3-horse crew.

TABLE XV.—*Hauling.*

District.	Per cent of all records.	Acres in beets per farm.		Tons hauled per acre.	Miles hauled.	Hours of labor per acre.		Labor cost per acre.	Labor cost per ton.
		Total.	Hauled.			Man.	Horse.		
Caro	100	15.06	15.00	9.73	1.59	12.09	24.18	$4.62	$0.48
Alma	100	9.54	9.47	11.63	4.21	20.50	41.46	8.25	.70
Grand Rapids	100	6.40	6.14	10.40	2.90	17.72	37.14	7.25	.73
Northwestern Ohio	95	15.29	14.46	13.30	2.57	19.10	37.55	7.58	.56

The average distance to loading station or sugar-factory beet dump is 2.47 miles. Of 315 men reporting on hauling, 62 per cent hauled less than the average distance, and 38 per cent more than the average. Thirty-eight per cent hauled an average of 1.91 miles. Seven per cent hauled an average of 6.82 miles. Those men who hauled an average of 1.91 miles did so at a cost of 48 cents per ton less than the men who hauled over 5½ miles, or an average of 6.82 miles. (See Table XVI.)

TABLE XVI.—*Relation of distance from loading station to cost of delivering sugar beets.*

Distance (miles).	Average distance.	Per cent of all records.	Labor cost per ton.
	Miles.		
1 or less	0.63	25	$0.39
1 to 2½	1.91	38	.53
2½ to 4	3.33	24	.65
4 to 5½	4.79	6	.77
Over 5½	6.82	7	1.01

VARIATIONS IN FIELD PRACTICE.

Certain field methods in growing and handling sugar beets are common to all areas. On the other hand the desired results are often accomplished in a number of different ways. Variations in field practice may be due to the condition of the soil at the time the work is done. Some fields may have to be disked more than once and the soil may require extra treatment with the spring-tooth harrow. Perhaps in other cases it may be possible to put the field in good condition for seeding merely by using the spike-tooth harrow. Climatic conditions usually govern the methods that must be employed in handling the growing crop. The handwork, such as blocking and thinning, hoeing, and topping, is usually done on a contract basis, though a part of this work may in some instances be done by the owner or renter. Occasionally all of the handwork may be done by the farmer, his family, and hired hands. A few of these features are illustrated in Tables XVII to XX, which were prepared in order to show variations in farm practice for 10 representative farms in each of the 4 districts included in this survey.[1]

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[1] Under the operations "removing trash" and "manuring" the fractional numbers indicate the portions or parts of the total beet acreage on which it was necessary to do some cleaning up after the preceding crop, or they indicate the part of the total area that received a treatment of barnyard manure. Referring to the table for the Caro district, it will be observed that Farm No. 1 manured one-tenth of the beet acreage; Farm No. 2 covered two-tenths or one-fifth of the beet land with manure, while Farm No. 5 treated one-half of the beet acreage with an application of manure. The manuring was done chiefly in the late fall and the early spring months.

TABLE XVII.—*Variations in farm practice in production of sugar beets, Caro, Mich.*

Operations.	Farm No. 1.	Farm No. 2.	Farm No. 3.	Farm No. 4.	Farm No. 5.	Farm No. 6.	Farm No. 7.	Farm No. 8.	Farm No. 9.	Farm No. 10.
	Times over.	*Times over.*	*Times over.*	*Times over.*	*Times over.*	*Times over.*	*Times over.*	*Times over.*	*Times over.*	*Times over.*
Plowing	1	1	1	1	1	1	1	......	1	1
Disking	1	4	4	......	......	......	1	2	2	1.1
Floating	1	1	1	......	1	2	1	1	......	......
Harrow (spike)	2	......	......	2	......	1	1	2	1	1
Harrow (spring)	1	2	2	4	4	3	2	4	2	3
Rolling	......	......	......	2	1	......	1	2	2	1
Hauling fertilizer	......	1	1	1	......	1	1	1	......	1
Planting [a]	1	1	1	1	1	1	1	1	1	1
Rolling beets	1	......	2	......	1	2	2	1	......	......
Cultivating	3	5	4	4	4	5	4	4	4	3.6
Blocking and thinning	(b)	(b)	(b)	(b)	(b)	1	(b)	(b)	(b)	(b)
Hoeing, first	(b)	(b)	(b)	(b)	(b)	1	(b)	(b)	(b)	(b)
Hoeing, second	(b)	(b)	(b)	(b)	(b)	......	(b)	(b)	(b)	(b)
Topping	(b)	(b)	(b)	(b)	(b)	1	(b)	(b)	(b)	(b)
Lifting	1	1	1	1	1	1	1	1	1	1
Hauling	1	1	1	1	1	1	1	1	1	1
Removing trash	......	......	.5	......	......	......	......	......	......	......
Manuring	.1	.2	......	.2	.5	.1	......	.2	.1	......
Man hours per acre	26	35	40	42	42	123	38	34	30	40
Horse hours per acre	48	72	92	94	74	65	74	71	63	77
Yield per acre (tons)	4.0	12.0	10.0	9.8	7.1	9.0	9.0	10.0	6.0	6.1
Total cost per acre	$45.56	$47.73	$46.78	$50.91	$49.50	$48.33	$47.64	$49.05	$45.68	$45.90

[a] Applying fertilizer is included in the planting operation. [b] Contract.

TABLE XVIII.—*Variations in farm practice in production of sugar beets, Alma, Mich.*

Operations.	Farm No. 1.	Farm No. 2.	Farm No. 3.	Farm No. 4.	Farm No. 5.	Farm No. 6.	Farm No. 7.	Farm No. 8.	Farm No. 9.	Farm No. 10.
	Times over.	*Times over.*	*Times over.*	*Times over.*	*Times over.*	*Times over.*	*Times over.*	*Times over.*	*Times over.*	*Times over.*
Plowing	1	1	1	1	1	1	1	1	1	1
Disking	......	1	1	......	......	1	3	4	......	......
Floating	1	1	......	2.1	2	1	1	1	1	1
Harrow (spike)	......	1	3	1	2	1	4	2	2	1
Harrow (spring)	3	2	1	5.1	2	2	......	1	3	4
Rolling	2	1	2	.5	3	1	2	2	1	1
Hauling fertilizer and seed	.5	......	1	......	1	1	......	......	......	......
Planting [a]	1	1	1	1	1	1	1	1	1	1
Rolling beets	......	2	1	......	1	1	......	1	......	......
Cultivating	9.2	4	6	6	6	6	5	5	6	8
Blocking and thinning	(b)	1	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
Hoeing, first	(b)	1	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
Hoeing, second	(b)	1	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
Topping	(b)	1	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
Lifting	1	1	1	1	1	1	1	1	1	1
Hauling	1	1	1	1	1	1	1	1	1	1
Removing trash	......	......	......	......	......	......	......	......	......	......
Manuring	.2	.2	.2	.1	.3	......	.1	.1	.1	.3
Man hours per acre	49	140	42	46	52	42	56	44	40	53
Horse hours per acre	82	77	79	82	110	83	102	95	76	98
Yield per acre (tons)	15.1	7.0	11.0	11.0	14.5	14.0	13.2	10.0	13.0	12.0
Cost per acre	$52.42	$46.37	$53.85	$50.28	$60.37	$68.54	$55.92	$67.48	$54.39	$55.49

[a] Applying fertilizer is included in the planting operation. [b] Contract.

TABLE XIX.—*Variations in farm practice in production of sugar beets, Paulding, Ohio.*

Operations.	Farm No. 1.	Farm No. 2.	Farm No. 3.	Farm No. 4.	Farm No. 5.	Farm No. 6.	Farm No. 7.	Farm No. 8.	Farm No. 9.	Farm No. 10.
	Times over.	*Times over.*	*Times over.*	*Times over.*	*Times over.*	*Times over.*	*Times over.*	*Times over.*	*Times over.*	*Times over.*
Dragging	......	......	......	......	......	......	......	......	......	1
Manuring	......	......	0.2	......	......	......	0.1	0.3	0.1	......
Plowing	1	1	1	1	1	1	1	1	1	1
Disking	......	2	2	......	2	1.5	2.3	......	......	......
Floating	......	......	1	......	......	......	.7	2	......	2
Harrow (spike)	1	2	3	1	1	2.2	2	6	3	2
Harrow (spring)	1	......	2	1.5	......	......	......	......	......	......
Rolling	......	1	1	......	1	2	.3	2	2	......
Hauling fertilizer [a]	......	......	......	......	1	......	1	1	1	1
Fertilizing	......	......	......	......	......	......	......	......	......	1
Planting	1	1	1	1	1	1	1	1	1	1
Rolling beets	......	......	2	.2	......	......	2	1	2	......
Cultivating	2	5	8	3	4	3	4	4	2.5	4
Blocking and thinning	(b)	1	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
Hoeing, first	(b)	1	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
Hoeing, second	(b)	......	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
Topping	(b)	1	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
Lifting	1	1	1	1	1	1	1	1	1	1
Hauling	1	1	1	1	1	1	1	1	1	1
Man hours per acre	48	101	57	34	48	19	50	40	25	39
Horse hours per acre	90	82	128	72	100	55	100	73	53	74
Yield per acre (tons)	13.2	11.0	13.8	15.0	17.0	14.0	14.0	13.8	11.0	11.8
Cost per acre	$53.87	$44.30	$61.21	$51.02	$56.76	$54.00	$59.34	$57.37	$51.86	$51.25

[a] Fertilizer is usually applied in the planting operation. [b] Contract.

TABLE XX.—*Variations in farm practice in production of sugar beets, Grand Rapids, Mich.*

Operations.	Farm No. 1.	Farm No. 2.	Farm No. 3.	Farm No. 4.	Farm No. 5.	Farm No. 6.	Farm No. 7.	Farm No. 8.	Farm No. 9.	Farm No. 10.
	Times over.	*Times over.*	*Times over.*	*Times over.*	*Times over.*	*Times over.*	*Times over.*	*Times over.*	*Times over.*	*Times over.*
Dragging corn stubble	......	......	......	......	1	......	......	......	......	......
Manuring	......	......	0.5	0.1	.3	......	0.2	......	0.1	0.4
Plowing	1	1	1	1	1	1	1	1	1	1
Disking	......	4	......	......	......	2	4	......	......	......
Floating	......	2	......	......	1	......	......	......	1	......
Harrow (spike)	1	1	1	......	......	4	1	2	1	1
Harrow (spring)	3	2	3	4	4	......	......	3	4	3
Rolling	1	2	......	2	......	2	......	2	1	1
Hauling fertilizer	......	......	1	1	1	......	1	1	1	1
Planting [a]	1	1	1	1	1	1.1	1	1	1.2	1
Rolling beets	1	2	......	......	......	......	......	......	......	......
Cultivating	5	6	5	5	5	4	4	5	5	8
Blocking and thinning	(b)	1	(b)	(b)	(b)	(b)	(b)	(b)	1	1
Hoeing, first	(b)	1	1	(b)	(b)	(b)	(b)	(b)	1	1
Hoeing, second	(b)	......	......	(b)	(b)	(b)	(b)	(b)	1	......
Topping and pulling	(b)	1	1	(b)	(b)	(b)	(b)	(b)	1	1
Lifting	1	1	1	1	1	1	1	1	1	1
Hauling	1	1	1	1	1	1	1	1	1	1
Man hours per acre	45	102	75	42	28	52	29	54	153	113
Horse hours per acre	88	112	77	76	60	95	80	107	122	80
Yield per acre (tons)	8.0	10.2	10.5	18.0	12.0	13.2	10.8	9.5	8.0	4.0
Cost per acre	$50.47	$44.75	$46.96	$49.22	$45.09	$49.24	$60.50	$50.86	$59.08	$47.97

[a] Applying fertilizer is included in the planting operation. [b] Contract.

By consulting these tables it will be seen that there is considerable variation in the number of times certain operations were performed. Differences will also be noted in the method of procedure on these farms. Taking the Caro district as an illustration, plowing was a common operation on all farms except one, in which case sugar beets were planted upon bean ground. Some of the land was disked four times; the disking was done twice on a few farms, and in other cases but once; there were a few cases in which the disk was not used at all. Floating was practiced quite generally, but was not common to all farms. The spring-tooth harrow was used much more extensively than the spike-tooth in the preparation of the seed bed.

Rolling was done on some farms both before and after planting. A few men rolled prior to planting the seed and did not repeat the operation after the beets were up. On other farms this work was confined solely to "rolling beets."

The 10 Caro growers did not replant any seed, but in some of the other districts a fractional part of the acreage had to be reseeded. The number of cultivations varied from three to five in the Caro district. Only one operator in this group performed the handwork with the regular farm labor; the remaining growers contracted the blocking, thinning, hoeing, and topping.

COST OF PRODUCING SUGAR BEETS.

The cost of the various items of expense has advanced appreciably since 1915, and likewise the receipts have increased considerably. However, by substituting prevailing costs for the items of man labor, horse labor, pounds of seed, etc., the cost of producing sugar beets under present conditions can be closely approximated.

By a study of the data presented it is hoped that the beet grower will be able not only to measure his own beet enterprise, but also to judge the relative importance of each item that enters into the cost of producing sugar beets.

To find the cost of producing an acre of sugar beets in a given region the total cost of production was divided by the total beet acreage. Similarly the cost of producing a ton of sugar beets was found by dividing the total cost of production by the total number of tons of beets produced. All items of cost are computed on this basis. The final figures give the average cost of producing an acre or a ton of sugar beets on 2,018 acres of beets at Caro, Mich., 230 acres in the Grand Rapids, Mich., district, 506 acres at Alma, and 1,525 acres in northwestern Ohio, or a total acreage of 4,279 for all districts.

LABOR COSTS.

The labor required in producing sugar beets can be divided into three classes, man, horse, and contract. The last item consists mainly of man labor and is paid at a certain rate per acre or per ton. However, in a few cases where plowing or hauling was hired by the acre or by the ton, this item is classified under contract labor. The sum of the three items of labor gave the total labor cost for the four areas. Table XXI shows the labor cost of producing sugar beets in three areas in Michigan and one in northwestern Ohio.

TABLE XXI.—*Labor costs.*

District.	Number of farm records.	Total acres in beets	Labor cost per acre.	Yield per acre	Labor cost per ton.
				Tons.	
Caro	134	2,017.65	$31.40	9.73	$3.23
Alma	53	505.79	35.21	11.40	3.09
Grand Rapids	36	230.53	34.19	10.16	3.36
Northwestern Ohio	97	1,524.65	34.02	13.17	2.58

The labor cost is by far the largest item of expense, constituting over 60 per cent of the total cost of production. This item was practically the same in the Grand Rapids and northwestern Ohio areas. It will be noticed, however, that the labor cost was about $4 less per acre in the Caro area than in the Alma district. This variation is probably due to the variation in beet acreage per farm. At Alma an average of 9.54 acres of beets per farm was grown; at Caro 14.51 acres. The labor cost per acre is usually less on a large acreage than on a small one, on account of the more efficient employment of labor. In some cases the preparation for a given operation consumed as much time as the work itself. This is especially true on a very small acreage, since the time required to get the team ready and go to the field is as great for a small field as for a larger field of beets.

At Caro 15.1 acres were grown per farm, and in northwestern Ohio 15.72 acres. The average yield in the former district was considerably smaller than in the latter, where it was necessary to handle more beets, and consequently more labor was required to do the work. Not only was the beet acreage per farm smaller at both Alma and Grand Rapids than at Caro, but the yields per acre were higher. These two factors influenced the labor cost per acre in the Alma and Grand Rapids areas.

COST OF MATERIALS.

The cost of materials includes the items of manure, fertilizer, and seed. The estimated value of the manure in the yard and the actual expenditure for seed and fertilizer are charged against the beets. Table XXII shows the cost per acre for each of these three items and the total cost of materials per acre and per ton.

TABLE XXII.—*Cost of materials.*

District.	Number of farm records.	Total acres in beets.	Cost per acre.				Cost per ton.
			Manure.	Fertilizer.	Seed.	Total.	
Caro	134	2,017.65	$1.90	$1.19	$2.34	$5.43	$0.56
Alma	53	505.79	2.92	.81	2.30	6.03	.53
Grand Rapids	36	230.53	2.68	1.22	2.13	6.03	.59
Northwestern Ohio	97	1,524.65	.74	.73	2.28	3.75	.29

The cost per acre for materials was the same at Alma and Grand Rapids, but was very much lower in northwestern Ohio. The small amounts of manure and fertilizer applied result in this low total charge per acre. Reduced to a ton basis the costs do not vary appreciably except in northwestern Ohio, where this item is approximately 50 per cent of the charge in the other groups.

MANURE.

From 6 to 22 per cent of the beet acreage received an application of manure. The smallest percentage manured occurred in northwestern Ohio and the largest at Grand Rapids. In the former area a number of growers turned under a clover sod, thus adding green manure to the land; consequently the cash charge in this district for farm manure is smaller. At Grand Rapids the dairy farms supply an adequate amount of farm manure. Comparing the acres in beets manured per farm, there is not a wide variation. At Grand Rapids 1.41 acres per farm received an application, and in northwestern Ohio 0.89.

The greatest cost per acre for manure was in the Alma area. Here, too, the application was the largest (14.3 tons), and the highest estimated value per ton ($1.10) was recorded. The rate of application and the estimated value per ton were essentially the same at Caro and Grand Rapids. However, since the acreage per farm was greater in the former than in the latter, the cost at Grand Rapids was 78 cents higher than in the Caro region.

Northwestern Ohio had the largest acreage in beets and the smallest area receiving an application of manure. Consequently the lowest charge for manure occurs in this district.

FERTILIZER.

In order to insure the beet plant a rapid and luxuriant growth it is the general practice in the areas studied to apply commercial fertilizers. The northwestern Ohio growers put on more fertilizer per acre than any of the other groups, averaging 171 pounds, but they paid about $3 less per ton than the Caro or Alma farmers, and $2 less than the Grand Rapids growers. However, only one-third of the beet acreage in the former area received an application of fertilizer, while 80 per cent of the Caro, 48 per cent of the Alma, and 73 per cent of the Grand Rapids acreage was so treated.

SEED.

Beet seed was purchased from the sugar factory at a cost of 15 cents per pound. The factory advises the farmer to sow 15 pounds per acre, thus making the cost of the seed $2.25 per acre. The seed is advanced to the farmer and its value is deducted from the money due the grower when the beets are delivered. No interest is charged the farmer for the money invested in the seed.

Some growers seeded their fields at a higher, some at a lower rate than 15 pounds to the acre, while others sowed the stipulated amount. Caro farmers averaged 15.3 pounds, Alma growers 15.5, Grand Rapids 14, while the northwestern Ohio group drilled in 15.1 pounds of seed per acre. This variation accounts for the difference in the acre cost of seed. The lowest rate of seeding and the lowest cost were found at Grand Rapids.

OTHER COST ITEMS.

Other cost items include insurance and taxes, use of land, machinery, and miscellaneous expenses. These are charges against the farm as a unit and must be prorated so that each enterprise will bear a just portion of the total expense. Table XXIII gives the cost per acre of these different items, together with the total cost per acre and per ton.

There was a wide variation in the acre charge for these costs. Northwestern Ohio had the highest cost, $18.27, while in the Caro district the cost was but $10.82. A glance at the table will show that the charge for the use of land causes most of this difference. Reduced to a ton basis, this variation becomes considerably less.

TABLE XXIII.—*The use of land and other cost items.*

District.	Number of farm records.	Total acres in beets.	Cost per acre.					Total cost per ton.
			Insurance and taxes.	Use of land and interest on cash.	Machinery.	Miscellaneous expenses.	Total.	
Caro	134	2,017.65	$1.00	$6.65	$2.07	$1.10	$10.82	$1.11
Alma	53	505.79	.80	11.69	2.45	1.24	16.18	1.42
Grand Rapids	36	230.53	.92	8.25	2.45	1.21	12.83	1.26
Northwestern Ohio	97	1,524.65	.91	13.79	2.45	1.12	18.27	1.39

INSURANCE AND TAXES.

Where the operator owned the land the insurance and taxes were greater than where the beets were grown by a tenant, since the man who rented had only his personal taxes to pay and usually carried no insurance. This charge is very small on tenant farms.

On farms operated by the owner of the land the percentage of the total real-estate investment covering the beet land was used in determining the proportion of the insurance and taxes chargeable against the beet crop. This item was about the same in Grand Rapids and northwestern Ohio and slightly greater at Caro. The lower charge of 80 cents at Alma is due to the high percentage of tenant farmers in this group. About 50 per cent of the growers in this area grew beets on rented land, while only about 10 per cent of the farmers at Caro and Grand Rapids rented the land.

USE OF LAND AND INTEREST ON CASH.

The largest item in the group comes under use of land and interest on cash. If the owner grows beets, the money invested in land should pay interest to the farmer. The current rate on first-mortgage notes in the locality was used in figuring the interest on the investment, which was taken as the charge for the use of the land.

It is the practice in all the areas to borrow money to pay the men who perform the hand work on the beet crop. Even if a man has the ready money to meet this expense, it means an investment of $7.50 to $10 an acre from the time the beets are blocked and thinned to the harvesting of the crop. In either case the interest on this money is rightly chargeable against the beet crop.

If the operator rents the land, he gives a share of the crop or pays a stipulated cash price per acre for the use of the land. In the former case, the value received for that portion of the crop given to the landlord is charged; in the latter, the actual cash payment. Several factors affect the rental charge, namely, the share given as rent, the yield per acre, and the percentage of share renters in the different groups.

In general, the value of the share of the beet crop given as rent exceeds the interest on the investment. The value of the share rent also exceeds the cash amount paid by the cash renters of beet land. The amount paid as rent must be sufficient to cover both interest on land and land taxes. Then, too, it must be remembered that there is more risk to the tenant who pays cash rent than to the one who gives a share of the crop. If the yield is low, the share renter gives a smaller number of tons of beets; while the cash renter pays the same amount, regardless of the yield. If a tenant gives to the landlord one-half of the crop, the value of the rent is greater than if only one-third or one-fourth were given. In northwestern Ohio this expense is over $2 higher than at Alma. Of a total of 14 share renters in the former area, 12 gave one-half of the crop as rent, one gave one-third, and one gave two-fifths. In the latter sections, three of the four share renters gave one-half and one gave only one-fifth of the crop. When the yield is high the value of the crop share is, of course, greater than when a low yield is produced. Northwestern Ohio farmers produced the highest yield per acre, Grand Rapids the lowest, the yields at Caro and Alma falling, in their respective order, between these two.

MACHINERY.

Certain farm implements, such as beet drill and lifter, are used exclusively in the production of sugar beets. The total annual expense of these implements must, therefore, be met by the beet crop. Other implements such as the plow, harrow, cultivator, wagons, etc., are used in common on all the crops grown on the farm. In this case, it is necessary to prorate the expense and charge the beets with a just proportion of the annual implement cost. Where machinery is hired, the actual cash paid out is considered. This was done in computing the machinery cost per acre of sugar beets. An average rate per acre was worked out for each district studied, and used for all the farms in that locality.

Since practically all of the implements employed were similar in the four regions, there is little variation in this charge, which was the same at Alma, Grand Rapids, and in northwestern Ohio, and a little lower in the Caro district.

MISCELLANEOUS EXPENSE.

There are a number of minor farm expenses, a portion of which every farm enterprise must stand, such as telephone, farm papers, interest on cash to pay regular farm help, and other general farm expenses.

This charge can be closely approximated, and, in this instance, is found by taking 3 per cent of the combined costs of materials and labor. There is very little difference in this charge for the four sections studied.

COST SUMMARY.

It is interesting to note the relative importance of the several classes of expense which, taken together, give the total cost of producing sugar beets. Table XXIV gives the percentage distribution of costs for all areas.

TABLE XXIV.—*Summary and distribution of costs.*

District.	Cost per acre.	Cost per ton.	Percentage distribution of costs.		
			Labor.	Materials.	Use of land and other costs.
Caro	$47.65	$5.62	65.9	11.4	22.7
Alma	57.42	5.04	61.3	10.5	28.2
Grand Rapids	53.05	5.21	64.4	11.4	24.2
Northwestern Ohio	56.04	4.26	60.7	6.7	32.6

The total cost per acre of producing sugar beets varied from $47.65 at Caro to $57.42 at Alma. This difference is due to three items—labor, manure, and rent. The cost per ton in the first three areas was above $5, while in the last district the cost was considerably below the five-dollar mark. It is interesting to note that the lowest cost per acre gave the highest cost per ton at Caro, and that the sections producing beets at a higher cost per acre than at Caro showed a lower cost per ton than the Caro figure. Here the difference in the yield per acre is the determining factor. The yield was low at Caro, and considerably higher in the other districts.

In order of importance, labor comes first, comprising over 60 per cent of the cost of production. "Other costs" come next, from 25 per cent to 32 per cent of the total, while materials constitute the remainder. It can be readily seen that any serious farm-labor problem is going to affect materially the cost of production of the sugar beet, since almost two-thirds of the total cost involves labor alone.

SUGAR BEET RETURNS VERSUS COST.

The sugar companies did not all pay a uniform rate to the farmer for his sugar beets. Several companies paid a flat rate of $6 a ton for beets either delivered on board the cars at the local shipping point or hauled to the factory bins. One company gave $5 a ton for the beets, plus an additional price, or bonus, per ton, depending on the increase in the New York market wholesale price for sugar above $5 per hundredweight, during the months of October, November, and December. Another sugar company paid for the beets on a sliding scale, dependent on the per cent of the sugar content of the beets. For beets testing 12 per cent, $5.25 a ton was paid, with an additional 40 cents per ton for each per cent above 12. Applying this scale, beets testing 13 per cent sugar were worth $5.65 a ton and 14 per cent beets brought $6.05 per ton.

It will be seen that, owing to the different methods of payment, the average receipts per acre will vary somewhat. In some cases in the same section, farmers contracted beets to different sugar companies and received different rates of payment.

Table XXV gives a comparison of the beet costs and receipts per acre and the margin above the cost of production received by the farmer.

TABLE XXV.—*Average returns and margin above cost in producing sugar beets.*

District.	Yield per acre. *Tons.*	Receipts per acre.	Cost per acre.	Net returns per acre for beets.	Net returns including beet tops.
Caro	9.72	$54.62	$47.65	$6.97	$8.67
Alma	11.40	68.40	57.42	10.98	13.16
Grand Rapids	10.16	61.31	53.05	8.26	11.34
Northwestern Ohio	13.17	71.83	56.04	15.79	17.60

The receipts per acre depend on the yield of beets produced and the amount received per ton. Northwestern Ohio growers received the lowest average price per ton, or $5.45; Grand Rapids growers got $6.03, the highest rate received; Alma, $6; and Caro, $5.62 a ton. The yield per acre is the greatest factor affecting beet receipts in the districts studied.

The net return per acre was obtained by subtracting the cost from the receipts, this item varying from $6.97 at Caro to $15.79 per acre in northwestern Ohio. When the estimated value of the beet tops is added to this figure, a net return is obtained which ranges from $8.67 to $17.60 per acre. The relation of the net returns from beets alone and the net returns including tops varies somewhat for the four areas, depending on the estimated value of the tops. At Caro beet tops were given a value of $1.70 an acre, at Alma $2.18, at Grand Rapids $3.08, and in northwestern Ohio $1.81.

In no section did the average cost of production exceed the average returns. However, some individual growers produced beets at a loss and some realized only a small net return. It is possible to increase the yields in many localities and thereby add appreciably to the net returns.

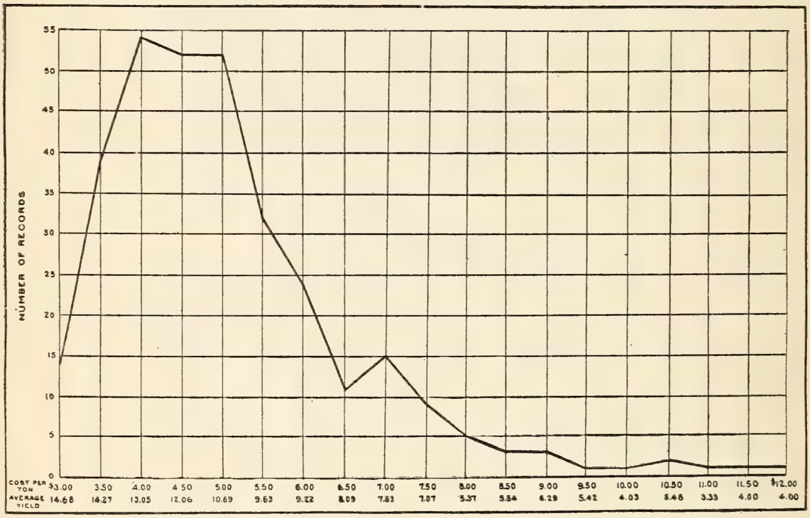

FIG. 23.—Frequency curve showing the distribution of farm operators in this study in relation to cost per ton and yield per acre.

RELATION OF YIELD TO COST OF PRODUCTION.

As has been previously stated, the yield per acre is an important factor in the cost of producing a ton of sugar beets. The accompanying frequency curve (fig. 23) shows the distribution of the growers in the four regions on the basis of cost per ton in producing sugar beets.

It will be seen that sugar beets are grown at a cost of from $3 to $12 a ton. However, from the 320 records obtained, 229 growers, or about 72 per cent, produced beets at a cost ranging from $3.50 to $5.50 a ton. Dividing the records into two groups, 145 growers produced beets at $4.50 a ton or less, and 175 grew the crop at $5 a ton or more. Twenty-three per cent of the growers reported a cost of $6 a ton or more.

The farmers received from $5.45 to $6.13 a ton for the crop. The margin of profit is very small in a number of cases, a condition which does not make for a greater beet acreage, a higher tonnage, or an increase in the sugar supply of the country. However, the farmer expends considerable labor on the beet crop and has been given an allowance for his own work. Then, too, several benefits are derived from growing the crop on the land. Since deep tillage and thorough land preparation are prerequisite, the soil is in excellent tilth for the following crop. This condition is shown in the high yields of grain after beets. Clean cultivation also eliminates noxious weeds and insures to the following crop comparative freedom from these pests.

The curve also points out the importance of a good yield of sugar beets as a means of decreasing the cost per ton. From a cost of $3 a ton there is a gradual decrease in the yield until the cost becomes $8 a ton. From this point a decrease does not always appear. However, only 4 per cent of the growers exceeded this figure.

It is possible in a number of instances to increase the yield by employing better tillage methods, by the proper use of manures, and by the use of a well-planned cropping system.

Recently the sugar companies have advanced the price paid to the farmer to help take care of increased costs. However, the general relation between the new price and the new cost of production remains practically the same. There are suggestions brought out in this study that might be used by the sugar company as well as by the beet grower. Increasing the efficiency of the labor necessary to raise the crop, and the performance of certain operations when these become necessary, will go far toward decreasing the cost of labor, which constitutes such a large part of the total expense; and also in increasing the yield of sugar beets. Both results would tend to lower the cost per ton of production.

VALUE OF BEET TOPS.

The value of beet tops depends on the manner in which this by-product is utilized. There are three ways of disposing of the tops, namely, feeding on the farm, selling, and plowing under for manure. The value given the tops on farms where they were fed was the probable sale price of other feeds replaced by the tops. On farms from which the tops were sold the actual price received was used. The estimated manurial value was used where the tops were plowed under.

The general practice was to feed the beet tops, over 96 per cent of the growers in the first three sections doing this. (See Table XXVI.) In northwestern Ohio about one-half of the growers fed and one-half plowed the tops under. Beet tops were valued at from

$1.50 to $3.40 an acre. The lowest figure is shown where the tops were plowed under for manure, while the highest value was placed on tops used as feed. Grand Rapids growers gave the highest estimated value for tops fed. In this area many farmers hauled the tops to the barn or feed lot and fed them to dairy cattle. In some sections the tops were pastured on the ground after the beets were harvested. In such instances many of the tops were trampled by the stock, while some spoiled because of unfavorable conditions and could not be used for feed.

TABLE XXVI.—*Disposition and estimated acre value of sugar-beet tops (1915).*

District.	Number of farm records.	Per cent feeding.	Value when fed.	Per cent selling.	Value when sold.	Per cent plowing under.	Value when plowed under.
Caro	68	97	$1.78			3	$2.00
Alma	51	96	2.20	2	$2.00	2	1.50
Grand Rapids	33	97	3.40			3	2.50
Northwestern Ohio	82	48	2.00			52	1.60

Some growers follow the practice of feeding a portion of the tops and turning under the remainder. In such cases, where the greater part of the acreage was fed, the value of the tops was higher than where the larger portion was turned under. The utilization of the tops depends largely on the amount of stock kept on the farm. Many farmers do not keep enough live stock to consume all of the beet tops produced on the farm. In some sugar-beet sections cattle and sheep are fattened for market. The stock is turned in on the beet field after the beets are harvested. When the beet tops are cleaned up, alfalfa and corn are fed until the stock is ready for the market. The feeding period lasts from two to five months. If the grower has no stock to fatten, he may sell the tops to a stock feeder, who turns his cattle and sheep into the farmer's field, paying a certain sum per acre for the pasturing privilege. Only two farmers sold all of their beet tops in this manner.

RELATION OF BEET ACREAGE TO TILLABLE AREA.

There was a decided variation in the size of the beet acreage per farm. Grand Rapids farmers grew the smallest acreage and northwestern Ohio growers the largest. There is also a difference in the acreage of tillable land per farm in the four sections. However, when reduced to a percentage basis there is little variation for these regions. Approximately three-fourths of the farm land is tillable; at Grand Rapids, 71 per cent; at Alma, 72 per cent; at Caro, 75 per cent; and in northwestern Ohio, 83 per cent. (See Table XXVII.)

Table XXVII.—*Relation of beet acreage to tillable area.*

District.	Number of farm records.	Acres per farm.	Acres per farm tillable.	Acres per farm in beets.	Per cent of tillable area in beets.
Caro	134	109.6	82.3	15.1	18.33
Alma	53	103.65	74.47	9.54	12.81
Grand Rapids	36	126.11	89.33	6.40	7.17
Northwestern Ohio	97	134.75	111.96	15.72	14.00

Only 7.17 per cent of the tillable land was planted to beets in the Grand Rapids area, while 18.33 per cent was given over to sugar-beet production at Caro. In the former area there has been a tendency on the part of the farmer to decrease his beet acreage. At one time all the sugar beets contracted by the Holland factory were produced in this locality. Most of the beets for that factory are now shipped in from points in northwestern Michigan and eastern Indiana. The scarcity of farm labor to perform the handwork on this crop is probably responsible for this situation more than any other one factor. In many instances larger acreages could be grown, since the sugar beet has a place in the crop rotation of this section.

BEET ACREAGE PER FARM AND YIELD PER ACRE IN RELATION TO COST.

It seems reasonable to assume that the man who grows a large acreage of sugar beets can produce them at a lower cost per acre than the man who grows a small acreage. In general this is true, but the variation is small (see Table XXVIII). It is also natural to suppose that the larger the yield in tons per acre the greater the cost per acre, since the handling of more beets is involved.

Table XXVIII.—*Acres in beets versus yield per acre as influencing cost of production.*

Acres in sugar beets.	Yield, 8 tons or less per acre.			Yield, 9 to 13 tons per acre.			Yield, 14 tons and over per acre.		
	Number of farms.	Cost per acre.	Cost per ton.	Number of farms.	Cost per acre.	Cost per ton.	Number of farms.	Cost per acre.	Cost per ton.
6 or less	13	$48.98	$8.10	46	$54.88	$4.94	19	$60.59	$3.76
7 to 12	22	49.28	7.05	47	52.45	4.83	25	58.18	3.92
13 and over	24	47.06	7.00	51	52.37	4.75	23	60.38	3.80

Comparing the farms in each group on the basis of yield per acre, it was found that in each of the three acreage groups the greater the yield of sugar beets per acre the higher the cost of production per acre. However, the larger the yield per acre the smaller the cost per ton of beets. Where 6 acres of beets or under were grown, it cost

$8.10 per ton to produce 8 tons or under per acre, and $3.76 per ton for a yield of 14 tons and over per acre. There is also an increase per acre and a decrease per ton in each of the other two acreage classifications in the table.

COMPARISON OF BEET RECEIPTS WITH OTHER FARM RECEIPTS.

An analysis of the receipts from the different enterprises on the farms in the sugar-beet areas studied shows the importance of the sugar beet to the farmer as a cash crop. Table XXIX gives a comparison of the percentage of farm receipts derived from the total farm crops, from live stock and live-stock products, from miscellaneous items, and from the sugar beet alone.

TABLE XXIX.—*Beet receipts in comparison with other farm receipts.*

District.	Number of farm records.	Average total receipts per farm.	Per cent of total receipts from—			Per cent of total farm receipts from beets.	Per cent of total crop receipts from beets.
			Crops.	Live stock.	Miscellaneous.		
Caro	84	$1,750.00	69.32	29.54	1.14	43.54	62.82
Alma	53	1,930.00	68.19	31.71	.10	33.83	49.62
Grand Rapids	36	2,339.00	41.04	58.79	.17	16.80	40.94
Northwestern Ohio	97	1,128.49	73.45	26.53	.02	35.72	48.63

The Caro, Alma, and northwestern Ohio farms are essentially crop farms, over two-thirds of all the receipts coming from crops in the first two areas and almost three-fourths in the last. At Grand Rapids almost 60 per cent of the total farm receipts was derived from live stock, while 40 per cent came from crops. This is not surprising, since farmers in the Grand Rapids region keep dairy cows and sell cream and milk to the creameries and cheese factory in that locality. Along with dairying go hogs and poultry, which provide a considerable portion of the live-stock returns.

In the former areas over one-third of the receipts came from the sugar beet alone, while beets brought in 17 per cent of the receipts at Grand Rapids. When changed to the basis of per cent of crop receipts over 40 per cent of the crop receipts came from beets, while at Caro they constituted over 60 per cent of the total crop receipts.

The highest total farm receipts were found at Grand Rapids. Live stock is probably responsible for this large amount. The lowest farm receipts were reported in northwestern Ohio. Over $2,000 was received per farm at Grand Rapids and slightly more than $1,100 in the northwestern Ohio region.

In several sections beans compete with the sugar beets. At Caro 20 per cent of the total farm receipts came from beans and at Alma 15 per cent. About 15 per cent of the farm receipts in northwestern Ohio was due to the sale of corn and 11 per cent to returns from oats.

LABOR REQUIREMENTS.

It is the general practice in all the areas studied to hire a part of the work on the sugar beets. Usually, if a man has more than 5 acres in beets all of the handwork is performed by hired help on an acre-contract basis. In some instances the hoeing was done by the farmer and his family, and the topping was hired; in other cases the hoeing was hired and the topping performed by the farmer. Where a very small acreage of beets was grown, usually none of the handwork was contracted. As stated previously, the contract labor was paid at a stipulated rate per acre or per ton. This contract expenditure has been changed to its equivalent in man hours by a computation assuming a rate of 25 cents per hour as the value of man labor. (See Table XXX.)

TABLE XXX.—*Labor requirements in producing an acre of sugar beets.*

District.	Acres grown.	Yield per acre.	Hours of man labor.	Hours of horse labor.
Caro	2,018	9.72	105.5	80.03
Alma	506	11.40	114.8	95.34
Grand Rapids	230	10.16	111.3	93.88
Northwestern Ohio	1,525	13.17	113.4	79.21

The number of horse hours spent at Caro and in northwestern Ohio are approximately the same, as are the hours for Alma and Grand Rapids. However, more labor was required in the former than in the latter areas.

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